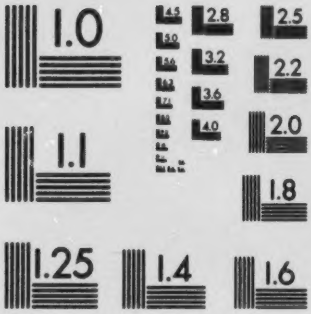

1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3
7.1

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

DOCUMENT RESUME

ED 204 530 CE 029 423

AUTHOR	Hotchkiss, Lawrence; Chiteji, Lisa
TITLE	The Dynamics of Career Expectations of Youth: A Theoretical Formulation and Empirical Report Based on a Longitudinal Study.
INSTITUTION	Ohio State Univ., Columbus. National Center for Research in Vocational Education.
SPONS AGENCY	National Inst. of Education (ED), Washington, D.C.
BUREAU NO	P-7
PUB DATE	81
GRANT	OB-NIE-G-81-0022
NOTE	258p.; For related documents see ED 186 705 and ED 193 493.
EDRS PRICE	MF01/PC11 Plus Postage.
DESCRIPTORS	Academic Achievement; *Career Choice; Career Development; Cognitive Ability; High Schools; *Influences; Longitudinal Studies; Models; *Occupational Aspiration; Parent Aspiration; *Parent Influence; *Peer Influence; Race; Sex; Socioeconomic Background; Socioeconomic Influences; *Student Attitudes

ABSTRACT

This report examines the process by which teenage youth develop expectations about their future educational achievements and occupational attainments. The focus of the study is on the dynamic feedback between the expectations of youth and parental expectations for the youth. The impact of academic performance, mental ability, and socioeconomic background of the youth on this feedback process also is an essential part of the analysis. A differential-equation model is written to represent the dynamics of the process and direct the empirical inquiry. The model is used to generate forecasts of senior-year expectations of youth and their parents, using sophomore- and junior-year data as inputs. The data were collected with a three-wave longitudinal panel design, using trained interviewers to deliver the questionnaires to the homes of students and wait until the youths and both parents had completed the questions. All analyses were carried out separately by race and sex. Findings included: career expectations of the youth were influenced by expectations held for them by their parents, but the parents were also influenced by their children; the influence of peers was much smaller than the influence of parents; and the development of career expectations remains stable over time. The study suggests some implications for career development. (KC)

****
* Reproductions supplied by EDRS are the best that can be made
* from the original document.
****

ED204530

THE DYNAMICS OF CAREER EXPECTATIONS OF YOUTH: A THEORETICAL FORMULATION AND EMPIRICAL REPORT BASED ON A LONGITUDINAL STUDY

by

Lawrence Hotchkiss
and
Lisa Chiteji

The National Center for Research in Vocational Education
The Ohio State University
1960 Kenny Road
Columbus, Ohio 43210

CE 029 423

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

1981

FUNDING INFORMATION

Project Title: A Predictive Test of an Occupational Decision-Making Model

Grant Number: OB-NIE-G-81-0022

Project Number: P-7

Educational Act Under Which the Funds were Administered: General Education Provisions Act, P.L. 96-88, Sec. 405

Source of Grant:
U.S. Department of Education
National Institute of Education
Washington, D.C.

Project Officer: Dr. Ronald Bucknam

Contractor:
The National Center for Research in Vocational Education
The Ohio State University
Columbus, Ohio

Executive Director: Robert E. Taylor

Project Director: Lawrence Hotchkiss

Disclaimer: This publication was prepared pursuant to a grant with the National Institute of Education, U.S. Department of Education. Grantees undertaking such projects under government sponsorship are encouraged to express freely their judgment in professional and technical matters. Points of view or opinions do not, therefore, necessarily represent official National Institute of Education position or policy.

Discrimination Prohibited: Title IV of the Civil Rights Act of 1964 states: "No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance." Title IX of the Education Amendments of 1972, Public Law 92-318, states: "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving federal financial assistance." Therefore, the National Center for Research in Vocational Education Project, like every program or activity receiving financial assistance from the U.S. Department of Education, must be operated in compliance with these laws.

CONTENTS

Page

LIST OF TABLES v

LIST OF FIGURES vii

FOREWORD ix

EXECUTIVE SUMMARY xi

1. INTRODUCTION 1

  Why Study Career Expectations? 1
  Theoretical Setting 5

2. THEORETICAL MODEL 9

  The Status Attainment Model 9
  A Dynamic Model of Career Expectations 14
  Theoretical Interpretations of the Dynamic Model 18
  Direct Effects, Indirect Effects, and Total Effects 24
  Commentary 33

3. METHODOLOGY 35

  Sample 35
  Data Collection Procedures 38
  Data Coding and Quality Checks 39
  Definition of Variables 40
  Data Analysis 49

4. EMPIRICAL RESULTS 57

  The Basic Model 57
  Forecasting Accuracy of the Basic Model 59

Page

Theoretical Features of the Basic Model 64
Effects of Peers and Income Expectations 75
Adjusting the Time Scale 78
Summary and Commentary 81

5. THEORETICAL EXTENSIONS 89

Time Scale Adjustments and Vacillation 89
Multidimensional Occupations and Utility Maximizing 93

6. SUMMARY, CONCLUSIONS, AND POLICY IMPLICATIONS 97

The Model 97
Method 97
Findings 98
Extensions 99
Policy Implications and Applications 102
Conclusions 103

APPENDIX A: Instrumentation, Data Collection, and Coding Methodology 107

APPENDIX B: Wave-Three Questionnaires 135

REFERENCES 247

LIST OF TABLES

Page

1. Correlations of Educational and Occupational Expectations with Educational and Occupational Attainments for Males 2
2. Sample Size by Race, Sex, and Time 36
3. Disposition of Students Drawn from the Sample Frame to Be Part of the Study 37
4. Forecasting R-Squares: Four Measurement Variations of the Basic Model 61
5. Forecasting R-Squares Comparing the Theoretical Model to Two "Naive" Models 63
6. Coefficients of the Differential Equations, Regression Coefficients, Eigenvalues, and R-Squares 65
7. Equilibrium Total Effects, Direct Effects, and Indirect Effects 70
8. Comparison of Long-Run Total Effects of SEB and MA as Estimated by the Differential Equations to Reduced-Form Regression Estimates of Total Effects: White Males 73
9. Forecasting R-Squares to Assess Peer Influence on Career Expectations 77
10. Forecasting R-Squares for Two Models Including Income Expectations 79
11. R-Squares for Adjusted Time Scale 80
12. Optimum Times Between Observations and Ratios of Optimum to Observed Times 82
13. R-Squares for Optimum Time Intervals and Naive Model of No Change 83

LIST OF FIGURES

Page

1. Simplified Version of the Status Attainment Model 10
2. Early "Wisconsin Model" of Status Attainment 11
3. Model of Career Expectations for Sophomore Males, Columbus Sample 13
4. Path Diagram Depicting Direct, Indirect, and Total Effects . . . 27
5. Time Paths of Endogenous Variables for Male Whites 72
6. Time Path of Occupational Expectation for One Individual Female Black 92

FOREWORD

Understanding the process by which young people formulate career plans is important to career and vocational education. The National Center for Research in Vocational Education therefore is pleased to have completed this unique longitudinal study of developing career expectations of youth. This is the final report from that study; it proposed a mathematical model to represent the way career plans change over time, develops a methodological philosophy of testing theory by evaluating forecast accuracy, and reports results of the data analysis.

The Columbus public school system has lent continuing support to the field work associated with this project. For this support, we express strong appreciation. Dr. Richard Beck of the Columbus Board of Education has been particularly helpful coordinating project activities.

Recognition is due to the authors of this report, Lawrence Hotchkiss and Lisa Chiteji. Le Dak Tang should be thanked for assistance in preparing data for this report. The diligent work of Deborah Cantan in typing a difficult manuscript is much appreciated.

Special thanks are due Archibald O. Haller, William Falk, and Paul Campbell for their scholarly reviews of this volume and to Ronald Bucknam of the National Institute of Education for his continued support and assistance. John Gardner of the National Center also offered useful suggestions. Final edit was done by Brenda Sessley of the National Center editorial staff.

Robert E. Taylor
Executive Director
The National Center for Research
in Vocational Education

EXECUTIVE SUMMARY

This volume analyzes empirical data from a three-wave longitudinal study of the process by which career expectations of youth develop. A fairly simple static model of career expectations is taken as a starting point; this model is drawn from sociological path models of status attainment processes. The static model is recast by use of simultaneous differential equations to express the dynamics of career expectations as they develop over time. The dynamic quality of the differential-equation model expresses the developmental nature of career expectations emphasized in the vocational psychology literature.

All analyses were carried out separately by race and sex. Several interesting patterns emerged from the data. For all four race-sex subgroups, substantial feedback between parents and youth was observed. Although the specific patterns differ across groups, in each sex-race combination, the career expectations of the youth were influenced by expectations held for them by their parents, but the parents were also influenced by their children. In the past, empirical study of parental influence generally has been carried out under the assumption that parents affect their children, but the children do not affect their parents.

The influence of peers on the career expectations of youth was found to be much smaller than the influence of parents. Also, income expectations of youth and of their parents had little influence on developing educational and occupational expectations and could not be forecast with reasonable accuracy. These are surprising results and therefore merit further study.

The development of career expectations do reveal a tendency to long-run stable equilibrium, with little tendency to oscillate over time. The expectation levels at equilibrium among whites are affected primarily by parental socioeconomic status and very little by mental ability; this pattern is not duplicated among blacks, however.

An unusual methodology was adopted for the empirical analysis. Rather than use all three waves of data to estimate coefficients of the model, all estimation was carried out with wave-one and wave-two data only. Forecasts of career expectations of youth and of parents for their children were then projected to wave three. The model was evaluated by checking the accuracy of those forecasts. For all four sex-race groups, the accuracy of the forecasts was remarkably high, but the main reason for the high accuracy resides in stability of youths' and parents' career expectations. Experimental "stretching" of the time scale led to substantial improvement of forecast accuracy.

The mathematical model of changes in career expectations is a preliminary representation of how youths' plans evolve over time. The volume proposes two extensions of that model. The first extension incorporates uncertainty of future attainment. Uncertainty is postulated to affect vacillation in expectation levels. The second extension adopts a multidimensional view of occupations and applies the economic utility model to describe how youth incorporate occupational characteristics and requirements into their decisions.

The concepts of total effect, direct effect, and indirect effect are given explicit definition with reference to specified time interval over which the effects operate. The different types of effects help to form a unified interpretation of the parameters of the differential-equation model and parameters of cross-lagged path models over varying lengths of time between measurements. The definitions are used to address important substantive issues related to status attainment.

Some implications for programs in career development may be drawn from the study. First, in order to avoid undue influence of family background on the career choices of youth, efforts should be increased to align youth's expectations with their interests and competencies. Secondly, involvement of parents and peers in career development programs may not be as critical as sometimes claimed. This conclusion is implied by the fact that effects of peers on career expectations were small, and by the observation that parental influence on their children was partially counterbalanced by a reciprocal effect of the youth on expectations their parents hold for that youth. Thirdly, the poor performance of income expectations in the present analysis suggests that youth could benefit from more information about the relationship between income, education, occupation, and level of living.

Although the work reported in this volume is primarily theoretical, the research offers potential for practical application in career development programs. For example, evaluation of career-development program activities could be improved by applying the forecasting model developed here to see if specified activities generate outcomes that are not forecasted in the absence of the activities. This type of application is particularly attractive because it combines theory with evaluation in a highly technical and specific way. Further, use of forecasts in evaluation is a more powerful methodology than is currently available. In addition, the study proposes theoretically pleasing measures of important aspects of career development such as uncertainty, realism, and "optimum" characteristics of a student's occupation. These measures could be used as diagnostic aids in career counseling.

CHAPTER 1

INTRODUCTION

This volume examines the process by which teen-age youth develop expectations about their future educational achievements and occupational attainments. The focus of the study is on the dynamic feedback between the expectations of youth and parental expectations for the youth. The impact of academic performance, mental ability, and socioeconomic background of the youth on this feedback process also is an essential part of the analysis. A differential-equation model is written to represent the dynamics of the process and direct the empirical inquiry. The model is used to generate forecasts of senior-year expectations of youth and their parents, using sophomore and junior-year data as inputs. The adequacy of the model is evaluated against the accuracy of the forecasts.

The data for the study were collected with a three-wave panel design. Questionnaires were hand carried to homes when the youth were high-school sophomores, again during the junior year, and, finally, during the senior year. Trained interviewers were used to deliver the questionnaires and wait in the home until the youth and one or both parents completed the questions.

Three reports related to the study have already appeared. The first of these is a small text explicating the differential-equation methodology in a form intended to make it comprehensible to social scientists with modest training in mathematics and statistics (Hotchkiss 1979). The second report contains an analysis of time-one data collected for the study (Hotchkiss and Chiteji 1979). The third report contains preliminary results from the first two waves of data collection (Hotchkiss and Chiteji 1980).

Why Study Career Expectations?

Although the present study is primarily a theoretical study, a part of this report addresses practical implications of the research. Discussion of practical implications is essential because of the importance of career expectations in the lives of individuals and the welfare of the nation. To set the study into a broad context, therefore, several aspects of the importance of career expectations are reviewed in the following paragraphs.

Career expectations and aspirations of youth exhibit substantial correlation with career attainments those youth will achieve when they become adults. Table 1 documents this point; it displays correlations between youth expectations and adult attainments. Each correlation is drawn from a longitudinal study in which a sample of high-school age youth was asked about career plans prior to leaving school then questioned again about attainments after leaving school. As indicated in the table, all correlations are of substantial magnitude. The correlations between educational expectation and educational attainment tend to be somewhat larger than the corresponding values for occupation; however, the combined impact of educational and occupational expectations on educational attainment and subsequent effect of educational attainment on occupational attainment reinforces the link between high-school career planning and adult occupational attainments.

TABLE 1

CORRELATIONS OF EDUCATIONAL AND OCCUPATIONAL EXPECTATIONS WITH EDUCATIONAL AND OCCUPATIONAL ATTAINMENTS FOR MALES

	Sewell & Hauser 1975 p. 93		Alexander & Eckland 1975 (Reported in Otto & Haller 1979)		Rehberg & Rosenthal 1978 p. 206		Wilson & Portes 1975 p. 351		Lenawee Co. Data Otto & Haller 1979	
	EE	OE	EE	OE	EE	OE	EE	OE	EE	OE
EA	.656	.580	.485	.393	.63	--	.51	.41	.700	.639
OA	.473	.476	.386	.364	--	--	--	--	.554	.570

NOTES: EE = Educational expectation as a youth

OE = Occupational expectation as a youth

EA = Educational attainment as an adult

OA = Occupational attainment as an adult

The importance of college plans in determining college attendance prompted the following evaluation in one important empirical study:

> What the presence of such a relatively high causal component in the relationship between decision and college entry suggests is that, within limits, ample latitude remains up to almost the end of the twelfth grade for the individual to decide whether or not to continue formal education beyond high school (Rehberg and Rosenthal 1978: 221).

A similar conclusion was proffered by Joseph Raelin, after empirical investigation of career development based on the National Longitudinal Survey:

> Since by far the most important attitude uncovered by this study in terms of its contribution to later work experience is career aspirations, every effort should be made to have the young person develop and sustain such aspirations throughout his/her early career. Having relatively poor jobs initially, disadvantaged youth may find aspirations to be the one way to turn things around (Raelin 1980: 132-133).

Although Raelin studied effects of aspirations of young adults rather than teenagers, the basic idea remains; aspirations affect attainment.

The fact that level of expectation of youth affects occupational level later on implies that the quality of the match between person and job is influenced by individual attitudes that form long before entry into the labor market. An important part of that match stems from the correspondence between one's desired job characteristics and the characteristics of the job one has. This correspondence has an important bearing on the job satisfaction one derives from work (see Andrisani 1978: 50; Kalleberg 1977). Kalleberg presents substantial evidence supporting this viewpoint; he concludes:

> This paper ... examined the variation in job satisfaction in terms of both perceived job characteristics and differences in work values. It has been demonstrated that work values have independent and significant effects on job satisfaction (1977: 141).

It seems clear that career aspirations and expectations of youth carry into adulthood thereby shaping the work values of the labor force. Assuming also that one's sense of personal satisfaction influences productive work behavior, then development of career expectations of youth influences productivity of the workforce for years into the future.

There is some debate over the connection between worker satisfaction and productivity. It is doubtful that individual worker satisfaction has a strong direct impact on short-run job performance (see Raelin 1980: 23). Job organization and real capital probably account for most of the variation in short-term productivity on the job. On the other hand, productivity is affected by numerous factors other than short-run job performance of individual workers. Labor turnover is costly because of time lost on the job, on-the-job learning time to acquire requisite skills, and cost of job search and possible change of residence. There is evidence that satisfaction affects job turnover (Andrisani 1978: 17). In addition, Andrisani reports evidence from the National Longitudinal Study that satisfaction has an important bearing on unemployment, labor-force participation, and growth in annual earnings. Certainly, employment status and labor-force participation affect total output. If people are not working they add nothing to the national product; in the technical sense, this is not the same as productivity, but it is closely related. Similarly, growth in earnings is not the same as productivity, but earnings are related to productivity; in contemporary economic theory, workers' wages equal their marginal product.

One of the most interesting items of evidence that worker satisfaction plays an indirect but important role in productivity can be garnered from observations of industrial "learning curves" (Thurow 1980). Learning curves refer to the increase in productivity of new industrial plants during the first two or three years of operation. Since the real capital remains approximately constant over this time period, productivity improvements are attributed to on-the-job learning about how to organize the work as well as acquisition of specific skills. The phenomenon was explicitly observed first during World War II in the production of Liberty ships. During the first months of operation, the number of person hours per ship declined sharply even though no new technology or capital goods had been adopted. Since this observation on production of Liberty ships, learning curves have been noted repeatedly in the civilian economy. In fact, they have become an important factor affecting investment decisions of major corporations.

The importance of learning curves to productivity is summed up by Thurow (1980) in the following terms:

> To raise investment it is necessary to improve the characteristics of the labor market. New skills and higher earning depend on new investments, but new investments also depend upon a cooperative work force. Simply raising the income of capitalists, with tax cuts that must be paid for with tax increases for workers, is unlikely to achieve either more investment or a higher growth of productivity. In generating more profitable investment opportunities, skill acquisition and a cooperative work force are as important as more funds to buy new equipment (1980: 84).

The important point for the present discussion is that a cooperative work force is encouraged by workers with high job satisfaction.

In brief form, the following argument may be constructed from the preceding discussion: Expectations of youth affect the job satisfactions they achieve as adults. Those satisfactions are important in their own right because of their influence on personal well being of the individual. Job satisfaction also contributes indirectly to productivity via its impact on job turnover, receptiveness to change in work rules, cooperation in determining more efficient procedures, unemployment, labor-market status, and change in annual earnings.

Examination of developing career expectations of youth should have spill-over effects into related areas of investigation. First, the conceptualization, methodology, and findings of the present research should transfer in large part to study of adult labor mobility. If mobility is partially dependent on job satisfaction, as reported by Andrisani, and satisfaction depends in important respects on expected desired features of the job, then the methodology for measuring occupational expectation of youth ought to have important transfer to study of adult mobility. The present study has developed a measurement methodology based on subjective probabilities that offer important potential for application with adults. If that measurement methodology were combined with careful conceptualization about how discrepancy between expected and observed job features affect satisfaction, important steps might be taken toward rational incorporation of the nontechnical aspects of work into a theory of productivity.[1]

In addition, study of developing career expectations is an important aspect of research on the general process of decision making. A voting decision is an interesting case illustrating the conceptual similarity between occupational choice and other types of choices. Just as is done with occupations in this study, one may conceive of a subjective probability for choice attached to each alternative. Presumably, those subjective probabilities depend on perceived similarities between desired characteristics and characteristics attached to the objects of choice, occupations or political candidates. Woelfel and Fink (1980) offer a similar conceptualization of the process of voting drawn from an emerging general theory of communication and decision making. Thus, the present work offers potential for contributing to general understanding of the process by which people make choices between mutually exclusive options.

Theoretical Setting

The theoretical model underlying the study is drawn from sociological work on the "status-attainment process." The main question motivating the status-attainment work is: What are the mechanisms by which statuses such as occupational level, education, and income are passed between generations? Particular attention is focused on occupational achievement of males. For example, it is observed universally that there is a direct association between the status of father's occupation and the occupational status of the son. The question is: Why? To achieve an empirical answer to this question, the status-attainment model proposes that a set of intervening variables "interpret," or account for the pervasive relationship between parental status and status of offspring. The basic hypotheses are that parental status affects school grades, career expectations that offspring hold for themselves, the expectations that others have for the offspring, and the educational attainment of the offspring. These variables, in turn, affect the occupational level achieved, thus generating a correlation between parental status and one's own occupational status, by a chain of effects. These hypotheses are expressed by path models that facilitate multivariate empirical tests. An impressive volume of empirical research lends support to the main ideas in the status attainment model (see Otto and Haller [1979] or Hotchkiss, et al. [1979] for recent reviews).

---

[1] See Hotchkiss (1980; 1981) for thorough development of the logical aspects of testing theory in which effects are attributed to discrepancies between independent variables.

The status-attainment model marks important advancements in the study of social stratification. Prior to development of the model, study of the relationship between achievements of parents and those of their offspring was confined largely to inspection of tables cross-classifying status groupings of occupation of father and occupation of son (e.g., Jackson and Crockett 1964). Introduction of path models to describe the status-attainment (mobility) process led directly to multivariate analyses in which the importance of numerous variables in the intergenerational transmission of status could be identified. Further, path analysis offers a quantification of the concept of indirect effect, permitting careful empirical analyses of the main hypotheses regarding indirect transmission of status from one generation to the next.

The status-attainment model describes important aspects of an entire life history, the "socioeconomic life cycle" (Duncan, Featherman, and Duncan 1972). In contrast, the present study focuses on a short segment of one's socioeconomic life: the teenage years. In particular, the present study draws on the status-attainment model as a beginning point for studying the process by which youth form career expectations.

In spite of the important contributions of the status-attainment model to the study of career expectations much room for improvement remains. First, the continuous nature of the formation of career expectations is not expressed in the structural-equation models of career expectations.[2] Secondly, most existing models do not permit two-directional cause-and-effect relations (feedback) among the career-expectation variables. Thirdly, appropriate criteria for choosing among competing hypotheses do not exist. Fourthly, nonstatus content of occupations generally is ignored. Fifthly, important descriptions of the process of forming expectations, such as the role of uncertainty, are ignored. Finally, almost no attention is devoted to the central concept: occupation.[3]

---

[2] In this report, path analysis and structural-equations are used interchangeably. The subtle differences between the two terms contribute nothing to the exposition herein.

The present study introduces a continuous-time model of developing career expectations that addresses the first three problems listed in the preceding paragraph. A simultaneous differential-equation model is used to express the theory. The model contributes to the solution of these three problems as follows:

- Expression of the continuous nature of the process of forming career expectations is achieved by using continuous-time mathematics to state the model.
- The feedback among important career expectation variables is stated by the simultaneous feature of the differential equations.
- Comparatively rigorous criteria for choosing among competing specifications of the theory are implicit in the differential-equation model. The model is used to generate forecasts of all career-expectation variables and the accuracy of the forecasts used to evaluate competing models.

The last of these items is critical to the methodological philosophy underlying this study and marks a fairly clear line of demarcation between the current work and normal practice in social science research. The philosophy in the present study is that theory testing, whenever possible, should proceed by checking the accuracy of forecasts that are generated by a model representing the theory. Two important results accrue from this strategy. First, constructing a model that will generate forecasts forces the theorist to consider the dynamics of the topic under study. Since theory so frequently refers to cross-sectional differences under the implicit equilibrium assumption, this is an important accomplishment. Secondly, testing theory by checking forecasts supplies an important criterion against which to evaluate alternative specifications of a model. In normal econometric work, extending to applications with LISREL, there is no final criterion for evaluating a model. Tests of overidentifying restrictions can be applied, but if the restricting assumptions are rejected they can be relaxed until statistical test fails to reject them. If necessary, restrictions can always be dropped to bring the model to a just-identified state, at which time all data are used up and no more tests are available. The importance of this argument can be seen by examining chapter 4 of the second report in this study (Hotchkiss and Chiteji 1979). In that chapter it is shown that even under the hypothesis of all possible feedback effects in cross-sectional data it is mathematically possible to identify each equation using ordinary least squares. This is an unorthodox conclusion, but mathematically it is permissible. In fact, the ordinary least squares supply a mathematical basis for a system of estimating equations that are inherently underidentified, thus showing that any number of mathematically equivalent solutions can be derived as linear transformations of the ordinary least-squares solution. Since the mathematical results apply whether the equation system refers to cross-sectional or longitudinal data, the conclusion of inherent underidentification is quite general (see Simon [1979] for recent commentary on this point).

---

[3] Some attention has been given to discerning different dimensions of occupations (e.g., Spaeth 1979; Goldthorpe and Hope 1972; Klatzky and Hodge 1971; Mortimer 1974); however, little attention is given to the definition of the fundamental unit, occupation. Differences between the census and DOT definitions illustrate the lack of agreement about the definition of occupation.

The authors of this report are acutely aware of the limitations of the status-attainment model due to factors such as omission of nonstatus dimensions of occupations, inability to account for uncertainty of career expectations, and the imprecise nature of the concept occupation. Some initial theoretical developments about the role of uncertainty and multidimensional nature of occupational expectation are contained in chapter 5, but limited resources curtailed the extent of such expansions of the theory.

CHAPTER 2

THEORETICAL MODEL

This chapter describes the differential-equation model underlying the study. The first section of the chapter reviews the status-attainment model and shows how it accounts for career expectations of youth. Although the status-attainment theory is familiar to sociologists, it is not as well disseminated outside of sociology. In order to engender among nonsociological readers a sense of continuity between past research and the present study, therefore, the review of the status-attainment model is relatively detailed. Section two of this chapter describes the differential-equation model and relates it to the status-attainment model. Section three presents alternative theoretical interpretations of the model. A fourth section develops explicit definitions for the concepts of total effect, direct effect, and indirect effect, and applies the definitions to the differential equations. The final section summarizes the chapter.

The Status Attainment Model

To present a parsimonious summary of the status-attainment model, it is useful to classify the variables of the model into four major groups: socioeconomic background (SEB), mental ability (MA), intervening expectation-performance variables (E-P), and socioeconomic attainment (SEA). Socioeconomic-background variables include status/demographic variables describing one's parents. Examples include father's occupational status, mother's occupational status, educational achievement of one's parents, and parental family income. Mental ability, in practice, refers to measurements obtained from written tests of intellectual performance. Expectation and performance variables include occupational and educational expectations that youth hold for themselves, the expectations that others hold for the youth, grades in high school, participation in high school athletics, and participation in nonathletic extracurricular activities during high school. The socioeconomic attainment variables include primarily one's own educational achievement, occupational status, and income.

With this classification, the main features of the status-attainment research paradigm can be presented succinctly in the following simplified diagram:

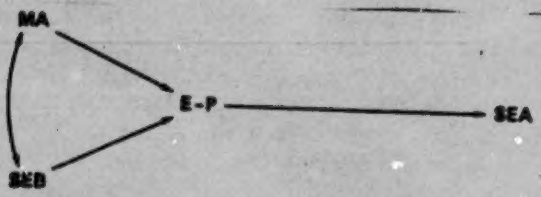


Figure 1. Simplified version of the status attainment model.

The curved, double-headed arrow connecting MA and SEB indicates a correlation between MA and SEB, but the model does not account for the cause-and-effect mechanisms that generate the correlation. The straight, single-headed arrows indicate effects running in the direction of the arrows. (See, however, Sewell and Hauser [1975], who show MA as a consequence of SEB.)

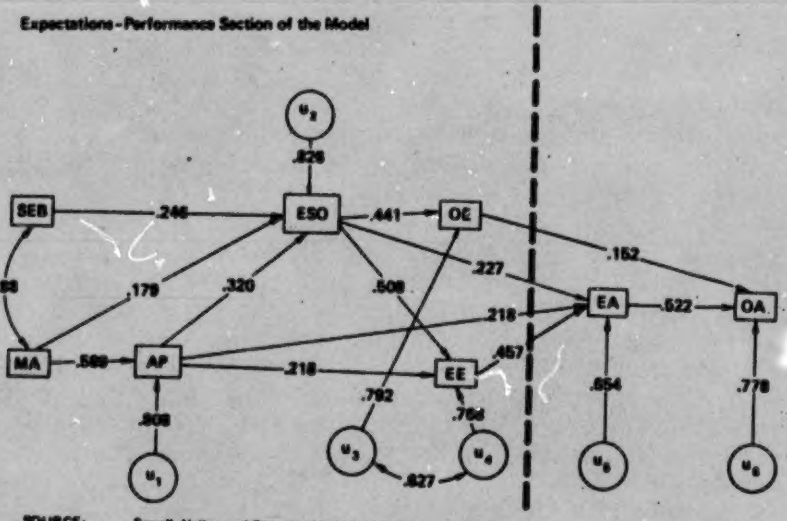
The following chain: SEB → E-P → SEA comprises the theoretical account of how socioeocnomic variables are transmitted between generations. The fundamental hypothesis is that background (SEB) affects expectation and performance variables (E-P), and E-P variables, in turn, affect attainment (SEA). The analogous chain originating with mental ability (MA → E-P → SEA) describes the theoretical effect of ability on attainment; according to the theory, MA also affects attainment indirectly, operating through its effect on expectation and performance variables. The simple chain model shown in figure 1 generates the empirical prediction that the relationships between background and attainment, and between mental ability and attainment, are reduced to zero when the expectation and performance variables are constant. Empirical research supports the theory in broad outline, but not in every detail (see as examples: Sewell, Haller, and Ohlendorf 1970; Sewell and Hauser 1975; Alexander and Eckland 1975; Otto and Haller 1979; Rehberg and Rosenthal 1978).

Numerous variations on the basic model depicted in figure 1 appear in the research literature. The original statement of the model by Blau and Duncan (1967) omitted mental ability and the expectation-performance variables. Numerous studies omit the attainment variables (SEA), and focus instead on the process by which career expectations develop during the teenage years (e.g., Hout and Morgan 1975; Picou and Carter 1976; Curry et al. 1976, 1978; Kerckhoff and Huff 1974). The present study is among those that concentrate on the development of career expectations among youth.

Although study of the process by which career expectations develop is of intrinsic interest, that interest is reinforced by the fact that expectations expressed during youth exhibit substantial correlation with adult achievement. This point is documented in chapter 1.

Models of Career Expectations

The major impetus to application of path models to the study of career expectations derives from the "Wisconsin Model" of status attainment. Sewell, Haller, and Portes (1969) and Sewell, Haller, and Ohlendorf (1970) proposed the germinal model in which career expectations were depicted as intervening between SEB and SEA. Figure 2 shows a path diagram of this model.[4] The socioeconomic background (SEB) variable is an index of parental-status characteristics composed of father's education, mother's education, father's occupation, and family income. The significant-other variable for education (ESO) is an index composed of three items as reported by the youth during his senior year in high school: parental "encouragement" to attend college, teacher "encouragement" to attend college, and friends' college plans. The other variables in the model



Expectations-Performance Section of the Model

SOURCE: Sewell, Haller, and Ohlendorf (1970: 1023)

VARIABLES:
SEB = Socioeconomic background
MA = Measured mental ability
AP = Academic performance (school grades)
ESO = Significant other variable for education
EE = Educational expectation of respondent when a senior in high school
OE = Occupational expectation of respondent when a senior in high school
EA = Educational attainment of respondent seven years after the senior year in high school
OA = Occupational status attainment of respondent seven years after the senior year in high school
u_i = Unmeasured residual variables

Figure 2. Early "Wisconsin Model" of status attainment.

---

4. Figure 2 displays a formal path diagram. The straight lines with one arrowhead denote a "causal effect." The numbers attached to these lines indicate standardized path coefficients. The curved line with two arrowheads indicates a correlation that is not analyzed into its causal components; numbers attached to the curved lines are correlations.

require no explication here. The data are for male Wisconsin residents surveyed first during their senior year in high school in 1957. More recent publications based on the Wisconsin data reveal evolution of the model shown in figure 2, most importantly by treating the items defining the SEB index and those forming the ESO index as separate variables (Sewell and Hauser 1975; Hauser 1972). For current purposes the more parsimonious version shown in figure 2 is sufficient.

There are four features of the model that are particularly pertinent to the present study. First, although both SEB and MA correlate to a moderate degree with the attainment variables (EA and OA),[5] neither SEB nor MA exert much direct effect on the attainment variables; this observation matches the parsimonious version of the model shown in figure 1. Secondly, the significant-other variable is an aggregate of three types of perceptions of ego:[6] ego's perception of parents' college encouragement, ego's perception of teacher's college encouragement, and ego's perception of the college plans of his/her peers. The important facts here are that the significant-other variable refers only to education, omitting reference to occupation; and the significant-other variable depends on ego's report of others' attitudes. Thirdly, no two-directional effects occur in the model. For example, academic performance (AP) is shown affecting the SO variable, but the SO variable is not shown to have an effect on AP. Finally, the path diagram does not express the dynamics of the process by which the expectation-performance variables develop over time.

The theory of career expectations and performance variables expressed by the Wisconsin model appears to the left of the vertical dashed line in figure 2. Numerous refinements and extensions of that model of career expectations have appeared in publication; notable examples include Hauser (1972), Sewell and Hauser (1975), Hout and Morgan (1975), Williams (1975; 1972), and Curry and associates (1976; 1978). The model developed by Curry and his associates is especially important to this report, because, in important respects, it is the intellectual percursor of the present research. Additionally, the sample studied in the reports by Curry and colleagues is comparable to the sample on which the present study is based (Hotchkiss and Chiteji 1979). Figure 3 reproduces the path diagram from the Curry work that is closest to the dynamic model of the present study. To preserve comparability with the Wisconsin data, figure 3 shows the results

---

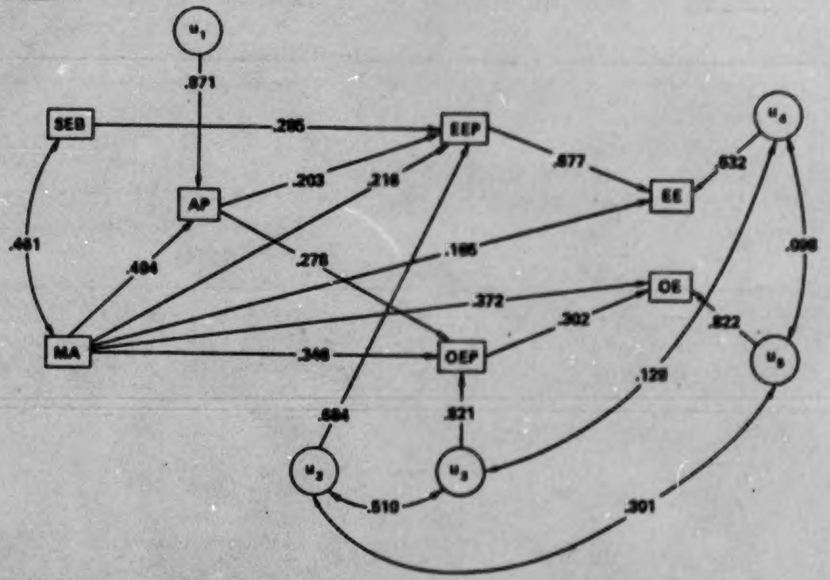
[5] The correlations in question are tabulated below:

	MA	SEB
EA	.486	.417
OA	.363	.331

Source: Sewell, Haller, and Ohlendorf (1970: 1018, total sample).

[6] The term ego refers to the individual on whom a "significant other" exerts influence; it serves a function similar to, but not precisely the same as, the function of "S" to reference the subject in a laboratory experiment with human subjects.

for white males, although the Curry data do contain race-sex comparisons.[7]



SOURCE: Curry, *et al.* (1978: 38-46)

VARIABLES:
SEB = Socioeconomic background
MA = Measured mental ability
AP = Academic performance (school grades)
EEP = Educational expectation of parents for their child
OEP = Occupational expectation of parents for their child
EE = Educational expectation of youth for self
OE = Occupational expectation of youth for self
u_i = Unmeasured residual variables

NOTE: Nonsignificant paths omitted.

Figure 3. Model of career expectations for sophomore males, Columbus sample.

In broad outline, the model of career expectations proposed by Curry and his associates resembles the career-expectation part of the Wisconsin model. There are four important differences in the significant-other variables, however. First, the significant-other variables refer only to parents. Teachers and peers are omitted. Secondly, parents' attitudes about their child's career were measured from responses provided by the parents rather than from the youth's perception of parental attitudes. Thirdly, parents were asked to provide a realistic expectation rather than encouragement. Finally, parents were asked to provide separate responses to questions about educational expectation of their child and occupational expectation of their child, thus generating separate significant-other variables for occupation and education.

---

7. Curry and associates (1978) also present a model in which mother's and father's educational and occupational expectations of their child are entered separately in the equations in which EE and OE are dependent variables.

One of the important findings of the studies by Curry and associates is that, for the Columbus sample, the parental SO variables measured by asking parents for information yields more satisfactory results than the significant-other variables available in the Wisconsin data. The multiple correlations with EE and OE were higher in the Columbus data when EEP and OEP were the significant-other variables than when the ESO index used in the Wisconsin model were used.[8] This result was replicated by Hotchkiss and Chiteji (1979). Moreover, the degree to which the SO variables "interpret" the correlations between SEB and the EE or OE is improved if EEP and OEP are the significant-other variables rather than the index used in the Wisconsin model (see footnote 8).

Two important features are shared by the Wisconsin model and the model proposed by Curry and associates: (a) neither model allows two-directional effects, and (b) both models are static in conception and in data analysis. The next section of this chapter proposes a differential-equation model of developing expectation and performance variables. The model contains two-directional effects, or causal feedback, and is expressed to describe change over time.

A Dynamic Model of Career Expectations

This section proposes a dynamic model of career expectations which includes causal feedback among the expectation and performance variables. The model is developed with the variables in figure 3. This selection of variables permits a reasonably parsimonious presentation.

The structural equations associated with the model in figure 3 are reproduced here as equation-system (1).

$$\text{(1a)}\quad AP = a_{10} + a_{11}SEB + a_{12}MA + u_1$$

$$\text{(1b)}\quad EEP = a_{20} + a_{21}SEB + a_{22}MA + b_{21}AP + u_2$$

$$\text{(1c)}\quad OEP = a_{30} + a_{31}SEB + a_{32}MA + b_{31}AP + u_3$$

$$\text{(1d)}\quad EE = a_{40} + a_{41}SEB + a_{42}MA + b_{41}AP + b_{42}EEP + u_4$$

$$\text{(1e)}\quad OE = a_{50} + a_{51}SEB + a_{52}MA + b_{51}AP + b_{53}OEP + u_5$$

where

SEB = Socioeconomic background

MA = Measured mental ability

AP = Academic performance (grade average)

---

[8] Using the disaggregated SO variable as it appears in later publications from the Wisconsin data does not change this conclusion.

EEP = Educational expectation of parents for ego

OE = Occupational expectation of parents for ego

EE = Educational expectation of ego for self

OE = Occupational expectation of ego for self

u_j = Disturbance variables

a_{ij}, b_{ij} = Empirical constants

The fact that equations (1) contain some coefficients for which arrows are missing in figure 3 is due to omission of statistically nonsignificant paths from figure 3; leaving out the nonsignificant paths simplifies the diagram improving its heuristic value without undue loss of information.

The usual procedure for empirical analysis with structural equations such as (1) is to apply regression methods to a cross-sectional sample of respondents. Viewed in this light, equations (1) express hypotheses about differences between individuals at a given point in time. Nothing explicit is contained in equations (1) about the over-time development of career expectations and performance variables. In contrast, theoretical accounts are quite explicit about changes over time in the expectation and performance variables. Donald Super is, perhaps, the most prominent theoretician emphasizing the developmental nature of career expectations. Super and associates write:

> *Vocational development is an ongoing continuous, and generally irreversible process*. Vocational preferences and competencies ... change with time and experience, making choice and adjustment a continuous process (Super et al. 1957: 89; emphasis in the original).

From a review of theoretical literature, Picou, Curry, and Hotchkiss conclude:

> ... all of the above theorists have implicitly or explicitly noted the developmental character of occupational choice and placement (Picou, Curry, and Hotchkiss 1976: 12).

Other theoretical discussions noting the dynamic character of career expectations include Ginzberg et al. (1951), Tiedeman (1961), Rodgers (1966), Beilin (1955), and Blau and associates (1956).

The causal feedback among important expectation and performance variables also has been noted in theoretical discourse. The feedback between educational and occupational expectations is quite explicit in a theoretical-empirical paper by Woelfel and Haller:

> Since there are two principal dependent attitudes in this research (educational and occupational aspirations) and since these two attitudes are known to be related to each other ..., we assume that each attitude exerts reciprocal influence on the other .... (Woelfel and Haller 1971: 79)

The fact that the methodology used by Woelfel and Haller to assess the reciprocal effects has been criticized (Land 1971; Henry and Hummon 1971) has no bearing on the quality of the theoretical argument.[9]

Reciprocal effects among other variables here classified as expectation-performance variables also have been posited in theoretical writing. Concerning feedback between significant others' attitudes and those of ego, Falk (1975) constructs a convenient diagram: SO → ego → SO. Hout and Morgan (1975) also raise the possibility of feedback between career expectations of youth and parental attitudes toward their children's careers, but find no empirical support for the hypothesis. Bell (1968) raises the general question of reciprocal cause-and-effect relationships in socialization of children within the family. Certainly, informal observation suggests that formation of career expectations of youth and the expectations that parents hold for their children is a give-and-take process that occurs gradually over time. Concerning the relationship between school grades (AP) and SO behaviors and attitudes, Hout and Morgan write:

> Parental encouragement is caused by the three family-of-origin variables and grades; grades are caused by intelligence and parental encouragement (Hout and Morgan 1975: 366).

This idea certainly is reasonable. Significant others such as parents judge the capacity of youth to achieve educational and occupational outcomes partly on the basis of the youth's academic performance. On the other hand, the effort youth exert in academic work probably is affected by expectations others have for the youth. An analogous argument applies to suggest a reciprocal relationship between academic performance and youth's career expectations for themselves.

The dynamic quality of the process of forming career expectations can be expressed by writing the structural equations as a system of differential equations. Dependent variables in the differential-equation system are rates of change with respect to time.[10] Since, in theory, causal feedback may occur in each pair of the expectation-performance variables, the differential equations should permit these feedbacks. A dynamic version of equations (1) containing all the hypothesized feedback loops is written in equation-system (2) below.

---

[9] See Hotchkiss and Chiteji (1979: chapter 4) for methodological argument that tends to support Woelfel and Haller's procedures.

[10] This is not always true with differential equations, but this interpretation is useful in the present context.

(2a) $dAP/dt = a_{10}+a_{11}SEB + a_{12}MA + b_{11}AP + b_{12}EEP + b_{13}OEP + b_{14}EE + b_{15}OE + u_1$

(2b) $dEEP/dt = a_{20}+a_{21}SEB + a_{22}MA + b_{21}AP + b_{22}EEP + b_{23}OEP + b_{24}EE + b_{25}OE + u_2$

(2c) $dOEP/dt = a_{30}+a_{31}SEB + a_{32}MA + b_{31}AP + b_{32}EEP + b_{33}OEP + b_{34}EE + b_{35}OE + u_3$

(2d) $dEE/dt = a_{40}+a_{41}SEB + a_{42}MA + b_{41}AP + b_{42}EEP + b_{43}OEP + b_{44}EE + b_{45}OE + u_4$

(2e) $dOE/dt = a_{50}+a_{51}SEB + a_{52}MA + b_{51}AP + b_{52}EEP + b_{53}OEP + b_{54}EE + b_{55}OE + u_5$

where the a_{ij} and b_{ij} are constants over time. Each equation in (2) has a rate of change with respect to time as the dependent variable. For example in (2d) the rate of change in the youth's educational expectation with respect to time (dEE/dt) is the dependent variable. The term dEE refers to change in EE and the term dt refers to an infinitesimal change in time. Since the change in time can be taken as small as desired, the hypothesis, in effect, accounts for every instant along a continuous time scale. The idea of feedback is expressed by the fact that the current level of each expectation-performance variable affects the rate of change in every other expectation-performance variable.

The differential-equation system (2) applies to change over time in a single individual. Since the dependent variables in the system are infinitesimal change rates, they are not observable. The fundamental hypotheses, therefore, are not testable directly. Integration of (2) between two time points that are a finite distance apart yields predictions that are amenable to empirical test. (See Platt 1971, Coleman 1968, Doreian and Hummon 1976, or Hotchkiss 1979a. The latter work presents the mathematics by reference to developing career expectations.) If it is assumed that all individuals follow the same process, then a cross-lagged unstandardized path analysis applied to two panels of data is sufficient to estimate the unknown constants in equations (2).

It is important to recognize, however, that the relationship between the cross-lagged coefficients and the fundamental parameters of the differential equation system is complex (Hotchkiss 1979a, Doreian and Hummon 1974). Let $\underline{A} = [a_{ij}]$ be a matrix of coefficients of the exogenous variables (MA and SEB) and the intercept, and let $\underline{B} = [b_{ij}]$ be the analogous matrix for the endogenous variables (AP, EEP, OEP, EE, and OE). Let $\underline{x}$ be a column vector with first element equal to 1.0 and remaining elements equal to values of the exogenous variables, $\underline{y}$ be a vector of current values on the endogenous variables, $\dot{\underline{y}}$ be the derivative vector, and $\underline{u}$ be the vector of unmeasured disturbances. System (2) can now be expressed as follows:

(3) $\dot{\underline{y}} = \underline{Ax} + \underline{By} + \underline{u}$

After integration, a vector of endogenous variables at time t, $\underline{y}_t$ can be expressed as a set of linear functions of the exogenous variables and the endogenous variables at time 0:

$$(4) \quad \underline{y}_t = \underline{A}^*\underline{x} + \underline{B}^*\underline{y}_0 + \underline{u}^*$$

where $\underline{A}^*$ and $\underline{B}^*$ are matrices of constants (over observations but not time) that can be estimated by regression, and $\underline{u}^*$ is a vector of residuals. Letting $\underline{I}$ designate a conformable identity matrix, the regression coefficients, $\underline{A}^*$ and $\underline{B}^*$, are connected to the parameters of the differential equation by the following formulas:

$$(5a) \quad \underline{B} = (\ln \underline{B}^*)/t$$

$$(5b) \quad \underline{A} = \underline{B}\,(e^{\underline{B}t} - \underline{I})^{-1}\underline{A}^*$$

(see, e.g., Hotchkiss [1979a] for thorough development of these formulas). The logarithm (ln) in equation (5a) is a matrix log.

It is clear from equations (5) that the cross-lagged regression constants ($\underline{A}^*$ and $\underline{B}^*$) should not be interpreted as direct causal parameters if the fundamental process is described by the differential equation (3). One of the most disconcerting aspects of such an interpretation is the fact that the cross-lagged coefficients depend on the length of the measurement interval between observations, t. It can be shown that the relative magnitudes and even the signs of the $\underline{A}^*$ and $\underline{B}^*$ coefficients change with the length of the measurement interval; whereas, the coefficients of the differential equation remain fixed, assuming the hypotheses expressed by (2) are correct (see Hotchkiss 1979a). Subsequent development in this chapter shows that $\underline{A}^*$ and $\underline{B}^*$ can be interpreted as accumulated total effects over a time interval of finite length.

Theoretical Interpretations of the Dynamic Model

The dynamic model expressed by equations (2) was presented by analogy with the typical cross-sectional model such as equations (1). The differential-equation system is highly abstract, however, and there are theoretically more satisfying ways to arrive at the differential-equation formulation. This section presents three ways to generate the differential-equation system and discusses the description of the development of career expectations contained in each derivation.

Interpretation as Cross-Lagged Path Model

To those familiar with path analysis, perhaps the most satisfying justification of the differential equations relies on a special case of a cross-lagged path model in which all endogenous variables at time t and Δt are written as linear functions of the exogenous variables and the endogenous variables at time t. Let $\underline{\alpha}$ and $\underline{\beta}$ be matrices of coefficients of the exogenous and lagged endogenous variables, respectively. Then a cross-lagged path model can be written as follows:

$$(6)\quad \underline{y}(t+\Delta t) = \underline{\alpha x} + \underline{\beta y}(t) + \underline{w}(t)$$

where $\underline{y}(t+\Delta t)$ and $\underline{y}(t)$ are vectors of the endogenous variables at time $t+\Delta t$ and t, respectively and $\underline{w}(t)$ is a vector of disturbances at time t. Without any loss of generality, one may simply define the following correspondences:

$$\begin{aligned} \underline{\alpha} &= \Delta t\underline{A} \\ \underline{\beta} &= \underline{I}+\Delta t\underline{B} \\ \underline{w}(t) &= \Delta t\underline{u}(t) \end{aligned}$$

Inserting these definitions in (6) produces the following form:

$$(6a)\quad \underline{y}(t+\Delta t) = \Delta t\underline{Ax} + (\underline{I}+\Delta t\underline{B})\underline{y}(t) + \Delta t\underline{u}(t)$$

Subtracting $\underline{y}(t)$ from both sides produces a difference equation:

$$(6b)\quad \underline{y}(t+\Delta t)-\underline{y}(t) = \Delta t\underline{Ax} + \Delta t\underline{By}(t) + \Delta t\underline{u}(t)$$

Dividing by Δt and letting $\Delta t \longrightarrow 0$ generates the differential-equation system (3).

This exercise reveals an interesting interpretation of the differential equations. They are a rearrangement of a cross-lagged path model in which the lag time between cause and effect approaches (but never reaches) the limiting value of zero. To take an example, this means that the effect of individuals' educational expectation on their occupational expectation occurs in a brief instant; for all practical purposes the effect is instantaneous. The same interpretation applies to the effect of occupational expectation on educational expectation. Yet there is, in both cases, the briefest instant of delay between cause and effect, so that the term simultaneous effect is a misnomer. Reciprocal effect or feedback is much more descriptive. Extending the same argument to the reciprocal effects between ego and his/her significant others, Falk's (1975) hypothesis of feedback between ego and SO is contained in the differential equations, but the cross-lagged path model with lag time approaching zero reveals this fact more clearly.

Viewing the differential-equation system as a special case of a cross-lagged path model shows that the differential equations do not really avoid the issue raised by Heise (1970) regarding the importance of knowing the lag time between cause and effect, as implied by Hannan and Tuma (1979: 320). Although the differential equations do solve the practical problem of determining the appropriate length of time between measurements and permit comparison of findings from studies with varying lengths of time between measurements, they do so precisely because they contain hypotheses asserting that the causal-lag time approaches zero. Once this fact is recognized, one may question the hypothesis of short lag, thereby reviving the issue raised by Heise.

The number of potential hypotheses about causal-lag time literally is infinite. This can be seen by deriving the integral equation (4) directly from (6a) without recourse to theorems in the integral calculus. This derivation can be carried out by iterative application of (6a) to $y(t+2\Delta t)$, $y(t+3\Delta t)$, ... and letting Δt approach zero.[11] The same algebraic form as formula (4) follows from (6a), however, even if Δt is a finite quantity. Hence, the empirical equation (4) is consistent with an infinite number of hypotheses about the length of the causal-lag time. The equations connecting the coefficients of the cross-lagged path analysis ($\underline{A}^*$ and $\underline{B}^*$), to the fundamental causal parameters ($\underline{A}$ and $\underline{B}$), on the other hand, do depend on the length of the causal lag. As the causal-lag time becomes small relative to the time between measurements, however, the differential equations give an increasingly closer approximation.

The presumption of this study is that the causal lag is short. This does seem like a reasonable assumption for the career expectation variables. For example, the effect of parental educational expectation for a youth on the youth's own educational expectation probably occurs within a relatively short time, say a few minutes; whereas, the time between measurements is several months.

Derivation from a Distributed-Lag Model

The preceding discussion derives from the assumption that, even when there is a lag between cause and effect, the effect occurs at an isolated point in time, in a manner quite analogous to the impact of a hammer on a nail. In theory a nail could be driven the same distance that it moves from one hammer blow by a persistent pressure. Similarly, it is possible that the effects of the career-expectation variables on each other persist over an indefinite period, perhaps due to the memory capability of individuals. An appealing formulation of the memory hypothesis is that effects of the expectation-performance variables on each other are strongest over a short time lag and taper off gradually over time. This idea can be expressed as a distributed-lag model. For expository purposes, take as an example a simultaneous distributed-lag model in which educational expectation (y_1)

---

[11] By repeated application of (6a) one finds:

$$\underline{y}(t+n\Delta t) = [\underline{I}+\Delta t\underline{B})^n-\underline{I}]\underline{B}^{-1}\underline{A}x + (\underline{I}+\Delta t\underline{B})^n\underline{y}(t) + \underline{u}^*$$

where $\underline{u}^*$ is a function of $\underline{u}(t)$, $\underline{u}(t+\Delta t)$, ... Let $\underline{B}^* = (\underline{I}+\Delta t\underline{B})^n$ and set $\underline{A}^* = (\underline{B}^*-\underline{I})\underline{B}^{-1}\underline{A}$. This is consistent with the relation for the differential equations given by equation (5). The relation over a finite time can now be written:

$$y(t+n\Delta t) = \underline{A}^*\underline{x} + \underline{B}^*\underline{y}(t) + u^*$$

which has the identical form to equation (4).

and occupational expectation (y_2) are two endogenous variables, and SEB (x) is an exogenous variable. Form the hypotheses:

$$(7a)\quad y_1(t) = a_{10}+a_{11}x+b_{12}y_2(t-\Delta t)+ {}_1b_{12}y_2(t-2\Delta t)+ {}^{2}_{1}b_{12}y_2(t-3\Delta t)+\ldots+u_1(t)$$

$$(7b)\quad y_2(t) = a_{20}+a_{21}x+b_{21}y_1(t-\Delta t)+ {}_2b_{21}y_1(t-2\Delta t)+ {}^{2}_{2}b_{21}y_1(t-3\Delta t)+\ldots+u_2(t)$$

$$0 \leq \lambda_1 < 1$$
$$0 \leq \lambda_2 < 1$$

Since the λ's fall between zero and one, the first equation states the hypothesis that educational expectation (EE) is a linear function of all past levels of occupational expectation (OE), but the impact of past OE on current EE declines monotonically with elapsed time. The second equation states the analogous hypothesis for the effect of EE on OE.

Besides the built-in "memory," the distributed-lag model in (7) has another appealing feature. In the distributed-lag model, past values of educational expectation are not "causes" of current values of educational expectation, and likewise for occupational expectation, since only past values of occupation appear in the equation for education, and only past values of education appear in the equation for occupation. In contrast, reference to (6a) shows that past values of each endogenous variable are important factors in affecting current values. An important element in the differential equations can be interpreted as follows: for each career-expectation variable, the past projects into the present according to a simple (curved) trend line. To the extent that this description characterizes the differential equations, the differential-equation model does not express very satisfactory theory.

In view of the preceding considerations, the fact that the differential-equation system can be derived from a distributed-lag model such as (7) gives an interesting theoretical interpretation to the differential-equation model. By a straightforward algebraic argument, (7) can be converted into the following form:

$$(8a)\quad y_1(t) = a_{10}(1-\lambda_1)+a_{11}(1-\lambda_1)x+\lambda_1y_1(t-\Delta t)+b_{12}y_2(t-\Delta t)+u_1{}^*(t)$$

$$(8b)\quad y_2(t) = a_{20}(1-\lambda_2)+a_{21}(1-\lambda_2)x+b_{21}y_1(t-\Delta t)+\lambda_2y_2(t-\Delta t)+u_2{}^*(t)$$

where $u_i{}^*(t)$ are disturbance variables. Subtracting $y_1(t-\Delta t)$ from (8a), $y_2(t-\Delta t)$ from (8b), dividing both equations by Δt and letting Δt approach zero generates a two-variable simultaneous linear differential equation system with the coefficient matrices defined by:[12]

---

[12] Of course, this result is nonsense unless the b_{ij} approach zero as Δt approaches zero, and the λ_i approach one as Δt goes to zero; otherwise, the coefficients in A and B would become infinitely large. This is not a problem, however, since no other behavior of the bs and λs makes any theoretical sense.

$$\underline{A} = \begin{pmatrix} a_{10}\,\frac{(1-\lambda_1)}{\Delta t} & a_{11}\,\frac{(1-\lambda_1)}{\Delta t} \\ \\ a_{20}\,\frac{(1-\lambda_2)}{\Delta t} & a_{21}\,\frac{(1-\lambda_2)}{\Delta t} \end{pmatrix} \qquad \underline{B} = \begin{pmatrix} \frac{\lambda_1 - 1}{\Delta t} & \frac{b_{12}}{\Delta t} \\ \\ \frac{b_{21}}{\Delta t} & \frac{\lambda_2 - 1}{\Delta t} \end{pmatrix}$$

Because of the connection between the differential equations and a continuous-time version of the distributed-lag model, two useful interpretations of the differential equations are warranted:

- The differential equations (3) are consistent with the idea that effects of career expectations and performance on each other persist over time due to "memory."
- The reason for the effect of past values of a given variable on its current value may be an accumulation of "memory-effects" of the other variables in the system. That is, the diagonals of $\underline{B}$ in equation (3) may be nonzero because they contain cumulated effects of memory.

It should be emphasized that these are permissible interpretations, not necessary ones. While the differential equations can be derived from a continuous-time version of a distributed-lag model, the distributed-lag model cannot be derived from the differential equations.

It should be noted that if the process followed the distributed-lag model, OLS estimation of $\underline{A}^*$ and $\underline{B}^*$ would be biased and inconsistent. Consequently, examination of the distributed-lag hypothesis is of methodological as well as theoretical interest. Unfortunately, resource limitations prohibit empirical investigation of the distributed-lag hypothesis in this report.

Interpretation as Equilibrium-Seeking Behavior

The cross-lagged path model and distributed-lag model depend on hypotheses about how the past determines the present. While change is implicit in these formulations, it is not an explicit part of the generating equations. There is heuristic value in formulating the hypotheses about determinants of change (Doreian and Hummon [1976] present useful examples of this approach). Consider the following completely general model of continuous-time change for a single variable, say OE:

(9) $dy_5/dt = k(y_5 - y_5^*);\ k < 0$

where k is a constant less than zero, and $\underline{y}_5^*$ is an equilibrium value of y_5 (y_5 = OE). Equation (9) stipulates that y_5 always changes in the direction of its equilibrium value of y_5^*, and the magnitude of k determines the rate of that change. If, for example, y_5 were larger than equilibrium (y_5-y_5^* is positive) multiplying the positive discrepancy by the negative constant k yields a negative change rate, dy_5/dt, so that y_5 declines in value toward y_5^*. Conversely, by analogous reasoning, if y_5 were below y_5^*, then the change rate would be positive thus moving y_5 toward its equilibrium.

If y_5^* is written as a linear function of SEB, MA, AP, EEP, OEP, and EE, one states the hypothesis that the equilibrium for occupational expectation is determined by these other variables which, therefore, affect the rate of change in occupational expectation. The linear function for y_5^* can be expressed as follows:

$$y_5^* = \alpha_0 + \alpha_1 x_1 + \alpha_2 x_2 + \alpha_1 y_1 + \beta_2 y_2 + \beta_3 y_3 + \beta_4 y_4 + u_5$$

Inserting this hypothesis into (9) gives

$$dy_5/dt = -k\alpha_0 - k\alpha_1 x_1 - k\alpha_2 x_2 - k\beta_1 y_1 - k\beta_2 y_2 - k\beta_3 y_3 - k\beta_4 y_4 + ky_5 - ku_5$$

$$dy_5/dt = a_{50} + a_{51} x_1 + a_{52} x_2 + b_{51} y_1 + b_{52} y_2 + b_{53} y_3 + b_{54} y_4 + b_{55} y_5 + v_5$$

with

$$a_{5j} = -k\alpha_j$$

$$b_{5j} = -k\beta_j,\ j = 1, \ldots, 4$$

$$b_{55} = k$$

$$v_5 = -ku_5$$

Analogous procedures produce linear hypotheses for the rate of change in the remaining endogenous variables, thus generating the complete system of linear differential equations. It should be noted that y_5^* at any given time is not the equilibrium value of y_5 that ultimately would occur if the system were permitted to operate indefinitely. Since y_5^* is a partial function of other endogenous variables which are, themselves, subject to change, y_5^* is a moving equilibrium. The value of y_5^* may or may not stabilize depending on the characteristics of the system of equations of which it is a part.

Equation (9) is a general formulation. It accommodates a wide variety of hypotheses about determinants of y_5^*. Of particular interest is the fact that postulating a distributed-lag model for y_5^* with lag time approaching zero can be used to generate the linear differential equations.

Direct Effects, Indirect Effects, and Total Effects

The matrices $\underline{A}^*$ and $\underline{B}^*$ in equation (4) may be estimated from a cross-lagged path analysis. The connection between the fundamental parameters of the model, $\underline{A}$ and $\underline{B}$, and the cross-lagged path coefficients can be found by rearranging equations (5); one thereby finds the manner in which $\underline{A}^*$ and $\underline{B}^*$ are generated by the fundamental parameters $\underline{A}$ and $\underline{B}$:

$$\text{(10a)} \quad \underline{A}^* = (e^{\underline{B}t} - \underline{I})\underline{B}^{-1}\underline{A}$$

$$\text{(10b)} \quad \underline{B}^* = e^{\underline{B}t}$$

From (10) it is clear that the cross-lagged path coefficients,[13] $\underline{A}^*$ and $\underline{B}^*$, depend in a complex way on the length of time between observations, t.

Since $\underline{A}^*$ and $\underline{B}^*$ do depend on the length of the measurement interval, their interpretation as effect parameters requires careful explication. To illustrate this point, compare the following two $\underline{B}^*$ matrices for three endogenous variables:

$$\underline{B}_1^* = \begin{pmatrix} .6 & .2 & .1 \\ -.1 & .5 & .44 \\ .5 & -.25 & .7 \end{pmatrix} \qquad \underline{B}_2^* = \begin{pmatrix} .39 & .195 & .218 \\ .11 & .12 & .518 \\ .675 & -.2 & .43 \end{pmatrix}$$

Interpretations of these two matrices as cross-lagged path matrices (independent variables across columns and dependent variables across rows) would give different results if $\underline{B}_1^*$ were used than if $\underline{B}_2^*$ were used. In $\underline{B}_1^*$ one observes, for example, that the magnitude of the diagonal entries equals or exceeds the magnitude of all other entries, thus indicating the strong effect of the lagged value of each variable on its current value. In $\underline{B}_2^*$, no such dominance of the diagonal entries occurs, especially for $b^*_{(2)22} = .12$. Additionally, in $\underline{B}_1^*$, the effect of variable 1 on variable 2 is negative: $b^*_{(1)21} = -.1$, but in $\underline{B}_2^*$ it is positive: $b^*_{(2)21} = .11$. In samples of medium to large size, both coefficients would be statistically significant. In spite of these discrepancies between $\underline{B}_1^*$ and $\underline{B}_2^*$, both were generated from the same differential-equation system. For this differential-equation system, $\underline{B}_1^*$ would be observed if measurements were taken after a lag time of one unit, and $\underline{B}_2^*$ would be observed after a lag time of two units.[14]

---

[13] Note that the exponentiation is a matrix exponential.

[14] In fact $\underline{B}_2 = (\underline{B}_1)^2$. See Hotchkiss (1979) for explication of this result and Doreian and Hummon (1974) for a similar observation applied to a single differential equation in status-attainment processes.

As shown by the illustration, two investigators studying the same career-expectation variables, one over a one-year interval and one over a two-year interval, might propose discrepant interpretations even though the fundamental processes generating the observations were identical. One of the merits of continuous-time theoretical models is that appropriate methods of comparisons between studies with different lag times between measurements follow directly from the theory (see Hotchkiss 1979a; Hannan and Tuma 1978).

The concepts total effect, direct effect, and indirect effect can be used to develop a unified interpretation of the instantaneous effect coefficients in $\underline{A}$ and $\underline{B}$, and the matrices of cross-lagged coefficients, $\underline{A}^*$ and $\underline{B}^*$. Since classification of effects into direct and indirect components is important in status-attainment research (e.g., Otto and Haller 1979; Sewell and Hauser 1975), and this study is one of the first applications of differential equations to status-attainment processes, the following paragraphs explicate interpretations of $\underline{A}$, $\underline{B}$, $\underline{A}^*$ and $\underline{B}^*$ by reference to the different types of effect. The discussion is organized into four parts. Part one defines the concepts: total effect, direct effect, and indirect effect. Part two applies the definitions to the differential-equation model. The third part shows the connection between the classification of total effects into direct and indirect components for differential equations to the same classification for cross-sectional structural equations. The final part briefly summarizes the main results.

Definitions

This section proposes definitions of the concepts of direct effect, total effect, and indirect effect. In contrast to past discussion of these concepts, the present definitions depend explicitly on change over time. Decomposition of correlations into causal components follows deductively for linear systems. The definitions proposed here are completely general, however; they are not confined to linear systems.

Direct effect. Let x and y denote two variables, and denote the length of a short-time interval by Δt; n is a positive integer. Let $y_D(t+n\Delta t)$ give the value of y at time $t+n\Delta t$ under the following conditions: (a) x changes during the interval prior to t $(t-\Delta t, t)$, (b) no variable other than x changes during the interval prior to t, and (c) no variable except y changes during the interval from t to $t+n\Delta t$. Then the direct effect of x on y over an interval of length $n\Delta t$ is the partial derivative:

$$DE_{yx}(n\Delta t) = \partial y_D(t+n\Delta t)/\partial x(t)$$

Total effect. Let x and y denote single variables, and let Y be a set of variables containing y; x may or may not belong to Y. Denote by $y_T(t+n\Delta t)$ the value of y at time $t+n\Delta t$ under the following conditions: (a) x changes during the interval prior to t $(t-\Delta t, t)$, (b) no variable other than x changes during the interval prior to t, and (c) no variables except members of Y change during the interval from t to $t+n\Delta t$. Then the total effect of x on y operating through Y over an interval of length $n\Delta t$ is the partial derivative:

$$TE_{yx}(n\Delta t) = \partial y_T(t+n\Delta t)/\partial x(t)$$

The direct effect of x on y is, therefore, a special case of the total effect in which the set Y contains only one variable, y.

Indirect effect. The indirect effect of x on y operating through Y over the time interval of length $n\Delta t$ is the difference between the total effect and direct effect operating over the same interval:

$$IE_{yx}(n\Delta t) = TE_{yx}(n\Delta t) - DE_{yx}(n\Delta t)$$

$$= \partial y_T(t+n\Delta t)/\partial x(t) - \partial y_D(t+n\Delta t)/\partial x(t)$$

$$IE_{yx}(n\Delta t) = \partial[y_T(t+n\Delta t) - y_D(t+n\Delta t)]/\partial x(t)$$

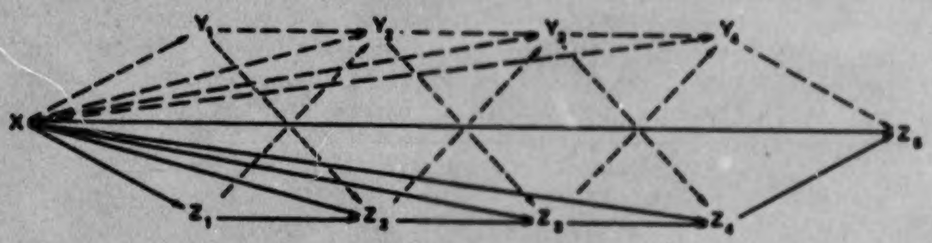
With these definitions of effects it is possible to propose explicit definitions of the concepts of exogenous and endogenous. In this context it is useful to let the term effect refer to the union of direct effect and total effect.

Exogenous variable. The variable x is exogenous to the set Y if and only if (a) for some $n\Delta t$, the effect of x on at least one member of Y is nonzero, and (b) for all $n\Delta t$, the effect of every member of Y on x is zero. For the first condition, the effects operate within the set Y; for condition b, the absence of effect refers to operation within the set x U Y.

Endogenous variable. The variable y is endogenous to the set Y if and only if for some $n\Delta t$: (a) the effect of y on at least one member of Y other than y is nonzero, and (b) the effect of at least one member of Y on y is nonzero. Both conditions refer to effects operating within Y.

Examples could probably be found in which the term endogenous is used when the first condition does not hold. But to define endogenous by the second condition alone creates an anomaly. Namely, it would be possible for the variable z to be endogenous to the set Y even though every member of Y were exogenous to z. The term dependent variable might be defined by the absence of condition a and presence of condition b.

To promote the clarity required to use these definitions in mathematical analysis, they are stated in formal terms. Informally, a change only in x followed by a change only in y indicates a direct effect of x on y. Holding everything but x constant during the initial time interval is a standard part of the concept of effect. Holding everything but y constant during the subsequent intervals is not the usual stipulation. It is required here to eliminate effects that generally are thought of as indirect effect, viz changes in y due to changes in a third variable that changed in response to the initial change in x. Figure 4 displays a schematic view of the different types of effect, assuming x is constant over the interval. In the figure, all routes from x to z_5 consisting exclusively of paths represented by solid lines are included as direct effect of x on z over five time segments. The lines connecting directly from x to $z_1,\ldots,z_5$ can be interpreted as the influence of continued pressure of the new value of x, as of time t and lasting to t+5t. The arrows from z_1 to z_2 to z_3 ... can be interpreted as the transfer of inertia in z from one time point to the next.



NOTES: Subscripts on Y and Z indicate the number of time segments from time t.

All routes from X to Z_5 in which only solid paths appear comprise the direct effect of X on Z over 5 Δt.

All routes from X to Z_5 in which one or more broken paths appear comprise the indirect effect of X on Y over 5 Δt.

All possible routes from X to Z_5 comprise the total effect of X on Z over 5 Δt.

Figure 4. Path diagram depicting direct, indirect, and total effects.

All routes from x to z_5 tracing over one or more dashed lines are defined as indirect effects of x on z operating through y. Note that each such route passes through y at least once. The accumulation of all routes from x to z_5 comprises the total effect of x on z over five time segments.

The importance of specifying n is particularly apparent by examining the special case where n = 1. Note the when n = 1, only the single arrow from x to z_1, occurs. This arrow represents the direct and the total effect of x on z. There is no indirect effect.

Application to Differential Equations

When Δt approaches its limiting value of zero, these definitions apply to the differential-equation model. This can be seen most readily by letting $\Delta t \longrightarrow 0$ and inspecting equation (6a), reproduced below for easy reference.

$$\underline{y}(t+\Delta t) = \Delta t\underline{A}\underline{x} + (\underline{I}+\Delta t\underline{B})\underline{y}(t) + \Delta t\underline{u}(t)$$

$$\lim \Delta t \longrightarrow 0$$

Certainly, as Δt approaches zero so does $\Delta t\underline{A}$ and the off-diagonal values of $(\underline{I}+\Delta t\underline{B})$. Thus, $\underline{A}$ and the off-diagonal entries of $\underline{B}$ are seen to be proportional to the direct effect of x on y and of lagged y on current y in the limiting case as lag time (Δt) approaches zero. Reference to equation (3) shows $\underline{A}$ and $\underline{B}$ are the fundamental parameters of the differential-equation system. As parameters of the differential equations, they also give the direct effect of x and y on the rate of change in y over time, in the limiting case as the increment in time goes to zero.

In the present context it is useful to attach time subscripts to $\underline{A}^*$ and $\underline{B}^*$; the time subscript makes explicit the fact that these matrices of cross-lagged coefficients depend on the length of the lag time between observations. With the time subscripts on the coefficient matrices, the integral equation (4) is written:

$$(11) \quad \underline{y}_t = \underline{A}_t^*\underline{x} + \underline{B}_t^* y_0 + \underline{u}_t$$

with

$$\underline{A}_t^* = (e^{\underline{B}t}-\underline{I})\underline{B}^{-1}\underline{A}$$

$$\underline{B}_t^* = e^{\underline{B}t}$$

Applying the definition of total effect by differentiating (11) with respect to $\underline{x}$ gives the total effect of $\underline{x}$ on $\underline{y}$ over an interval of length t:

$$(12a) \quad [\partial \underline{y}t/\partial \underline{x}]^T = \underline{A}_t^* = (e^{\underline{B}t}-\underline{I})\underline{B}^{-1}\underline{A}$$

where the superscript T stands for transpose of the matrix of partial derivatives.[15] A similar result gives the total effect of each y on every y over a finite interval:

$$(12b) \quad [\partial \underline{y}_t/\partial y_0]^T = \underline{B}_t^* = e^{\underline{B}t}$$

The interpretation of the matrices of cross-lagged coefficients is clear from these results: $\underline{A}_t^*$ gives the accumulation of total effects of $\underline{x}$ on $\underline{y}$ over a finite time interval of length t, and $\underline{B}_t^*$ gives the accumulation of total effects of the endogenous variables on each other over a finite time interval.

The direct effects of $\underline{x}$ on $\underline{y}$ and of $\underline{y}$ on each other can be found by applying the definition to each equation in the system; for example, take the first equation in the system represented by (3):

$$dy_1/dt = a_{10}+a_{11}x_1+\ldots+a_{1L}x_L+b_{11}y_1+\ldots+b_{1K}y_K+u_1$$

---

[15] The definition of differentiation of one vector by another indicates that dependent variables cross columns and independent variables cross rows, hence the necessity of the transpose notation.

where there are L exogenous and K endogenous variables in the system. To find $\underline{y}_D$, integrate this expression while holding all variables except y_1 constant. The result is

$$y_1(t) = (e^{b_{11}t}-1)\frac{a_{10}}{b_{11}} + (e^{b_{11}t}-1)\frac{a_{11}}{b_{11}}x_1+\ldots+(e^{b_{11}t}-1)\frac{a_{1L}}{b_{11}}x_L$$

$$+ e^{b_{11}t}\underline{y}_1(0) + (e^{b_{11}t}-1)\frac{b_{12}}{b_{11}}y_2(0)+\ldots+(e^{b_{11}t}-1)\frac{b_{1K}}{b_{11}}y_K(0)$$

Applying the definition of the measure of the direct effect of x_1 on y_1 over a time interval of length t, by differentiating with respect to x_1 gives:

(13a) $\partial y_1(t)/\partial x_1 = (e^{b_{11}t}-1)\dfrac{a_{11}}{b_{11}}$

Similarly, the direct effect of y_2 on y_1 over the interval is:

(13b) $\partial y_1(T)/\partial y_2(0) = (e^{b_{11}t}-1)\dfrac{b_{12}}{b_{11}}$

Matrices containing the direct effects of $\underline{x}$ on $\underline{y}$ and the direct effects of the $\underline{y}$ on each other can be expressed by letting $\underline{\not{B}}$ represent a diagonal matrix containing the diagonal entries of $\underline{B}$ as diagonal elements.

(14a) $(e^{\underline{\not{B}}t}-\underline{I})\underline{\not{B}}^{-1}\underline{A}$ = direct effects of $\underline{x}$ on $\underline{y}$ over t

(14b) $[(e^{\underline{\not{B}}t}-\underline{I})\underline{\not{B}}^{-1}\underline{B}+\underline{I}]$ = direct effects of $\underline{y}$ on each other over t

The indirect effects can be found by subtracting direct effects from total effects:

(15a) $[(e^{\underline{B}t}-\underline{I})\underline{B}^{-1} - (e^{\underline{\not{B}}t}-\underline{I})\underline{\not{B}}^{-1}]\underline{A}$ = indirect effect of $\underline{x}$ on $\underline{y}$ over time t

(15b) $[(e^{\underline{B}t}-\underline{I})\underline{B}^{-1} - (e^{\underline{\not{B}}t}-\underline{I})\underline{\not{B}}^{-1}]\underline{B}$ = indirect effect of $\underline{y}$ on each other over time t

These expressions for total, direct, and indirect effects over finite time interval of length t present a cumbersome appearance, but the indicated calculations are straightforward. Thus, for a given t one could calculate numerical tables of total, direct, and indirect effects; these tables could be inspected and interpreted. Since there are an infinite number of values of t, however, selection of t poses a practical difficulty. In some applications, selection of t may be implicit in the particular circumstance, but for theoretical interpretation two values of t are particularly useful. The first of these two is the limiting value: t ⟶ 0. Here, it has been noted that the fundamental matrices of the differential equation, $\underline{A}$ and $\underline{B}$, are proportional to the direct effects of $\underline{x}$ on $\underline{y}$ and of the $\underline{y}$ on each other, respectively. When t approaches zero, there is no indirect effect.

The second value of t with particular theoretical interest is the limiting value: t ⟶ ∞. Here one asks: What are the "long run" implications of accumulated effects over very short time intervals? Under fairly general conditions of equilibrium,[16] the long-run total, direct, and indirect effects of $\underline{x}$ on $\underline{y}$ are:

$$\text{(16a)}\quad TE(y,x) = -\underline{B}^{-1}\underline{A}$$

$$\text{(16b)}\quad DE(y,x) = -\cancel{\underline{B}}^{-1}\underline{A}$$

$$\text{(16c)}\quad IE(y,x) = (\cancel{\underline{B}}^{-1} - \underline{B}^{-1})\underline{A}$$

where TE(y,x), DE(y,x), and IE(y,x) denote total, direct, and indirect effect, respectively of $\underline{x}$ on $\underline{y}$. The analogous results for the effects of the $\underline{y}$ on each other are:

$$\text{(17a)}\quad TE(y,y) = \underline{0}$$

$$\text{(17b)}\quad DE(y,y) = (\underline{B}^{-1} - \cancel{B}^{-1})\underline{B}$$

$$\text{(17c)}\quad IE(y,y) = -(B^{-1} - \cancel{\underline{B}}^{-1})\underline{B}$$

where $\underline{0}$ is a K x K null matrix, TE(y,y), DE(y,y), and IE(y,y) denote total, direct, and indirect effects, respectively of the $\underline{y}$ on each other.

The fact that the total effect of the $\underline{y}$ on each other is zero, lim t→∞, implies that short-term intervention to change one of the endogenous variables will not be an effective way to bring about permanent change in any of the endogenous variables, even if, in some instances, the short-term effects of manipulating specific endogenous variables is greater than the short-term effects of manipulating exogenous variables. The policy implications of this feature of the theory are clear: The theory supports the frequently heard assessment that attempts to change youth in school have little impact because the youth must return to their home environments after school. The speed with which manipulations of $\underline{y}$ variables are lost as the system operates over time depends on the numerical entries in $\underline{A}$ and $\underline{B}$. Since schools cannot control the exogenous variables (SEB, MA), and their impact on the endogenous variables (such as EE) is of limited duration, analysis of the numerical results of this study will give useful insights pertaining to potential impact of school programs to assist with developing career expectations.

---

[16] The required equilibrium conditions are: (a) all diagonal entries of $\underline{B}$ are negative, and (b) all eigenvalues of $\underline{B}$ are negative.

Relationship to Structural Equations

By assuming equilibrium exists, these results for dynamic systems can be related to the concepts of total, direct, and indirect effect as they often are used with cross-sectional structural equations. In equilibrium, all change has ceased; hence the basic differential equation system (3) simplifies to

$$(18)\quad \underline{0} = \underline{Ax} + \underline{By} + \underline{u}$$

where $\underline{0}$ is a K x 1 null vector; $\dot{\underline{y}} = d\underline{y}/dt = \underline{0}$. Note that (18) exhibits the standard algebraic form of simultaneous structural equations. Solving for the $\underline{y}$ yields the reduced form, and differentiating with respect to $\underline{x}$ gives:

$$\underline{y} = -\underline{B}^{-1}\underline{Ax} - \underline{B}^{-1}\underline{u} \qquad \text{(reduced form)}$$

$$[\partial\underline{y}/\partial\underline{x}]^T = -\underline{B}^{-1}\underline{A}$$

Comparing this result to the total effect of $\underline{x}$ ($\lim t \longrightarrow \infty$) given in (16a), one finds that the total effect is contained in the matrix of reduced-form coefficients, $-\underline{B}^{-1}\underline{A}$, but this outcome depends on the equilibrium assumption. As will be illustrated in chapter 4, when equilibrium has not been reached, the reduced-form regression and total effects of exogenous variables may be quite different.

Recursive path models in cross-sectional data are encountered so frequently in empirical work on status attainment and expectation-formation processes that it seems worthwhile for expository purposes to specialize the above results for a small recursive system. Suppose there are one exogenous variable and two endogenous variables and that the following recursive system applies:

$$y_1 = a_{10}+a_{11}x$$

$$y_2 = a_{20}+a_{21}x+b_{21}y_1$$

These two equations can be rewritten and set in matrix notation matching the form of 18:

$$0 = a_{10} + a_{11}x - \quad y_1$$

$$0 = a_{20} + a_{21}x + b_{21}y_1 - y_2$$

$$\begin{pmatrix} 0 \\ 0 \end{pmatrix} = \begin{pmatrix} a_{10} & a_{11} \\ a_{20} & a_{21} \end{pmatrix} \begin{pmatrix} 1 \\ x \end{pmatrix} + \begin{pmatrix} -1 & 0 \\ b_{21} & -1 \end{pmatrix} \begin{pmatrix} y_1 \\ y_2 \end{pmatrix}$$

Applying formula (16a) to this equation system, one finds the usual formula for total effect given by decomposition of bivariate correlations (see, e.g., Duncan 1966):

$$-\begin{pmatrix}-1 & 0\\ b_{21} & -1\end{pmatrix}^{-1}\begin{pmatrix}a_{10} & a_{11}\\ a_{20} & a_{21}\end{pmatrix} = \begin{pmatrix}1 & 0\\ b_{21} & 1\end{pmatrix}\begin{pmatrix}a_{10} & a_{11}\\ a_{20} & a_{21}\end{pmatrix}$$

Performing the indicated row into column operation, the total effect of x on y_2 is found to be

$$TE(y_2,x) = b_{21}a_{11} + a_{21}$$

Simiarly, the total effect of x on y_1 is

$$TE(y_1,x) = a_{11}$$

since y_2 does not intervene between x and y_1.

The indirect effects can be found in similar fashion by use of equation (16c):

$$-\left[\begin{pmatrix}-1 & 0\\ b_{21} & -1\end{pmatrix}^{-1} - \begin{pmatrix}-1 & 0\\ 0 & -1\end{pmatrix}^{-1}\right]\begin{pmatrix}a_{10} & a_{11}\\ a_{20} & a_{21}\end{pmatrix}$$

$$=\left[\begin{pmatrix}1 & 0\\ b_{21} & 1\end{pmatrix} - \begin{pmatrix}1 & 0\\ 0 & 1\end{pmatrix}\right]\begin{pmatrix}a_{10} & a_{11}\\ a_{20} & a_{21}\end{pmatrix}$$

$$=\begin{pmatrix}0 & 0\\ b_{21} & 0\end{pmatrix}\begin{pmatrix}a_{10} & a_{11}\\ a_{20} & a_{21}\end{pmatrix} = \begin{pmatrix}0 & 0\\ b_{21}a_{10} & b_{21}a_{11}\end{pmatrix}$$

The indirect effect of x on y_2 thus is found to be: $IE(y_2,x) = b_{21}a_{11}$. This is the standard result for a system of three recursive equations.

Recapitulation

The above development accomplishes several important results. First, the concept of effect in a system of equations is defined with explicit reference to change over time. Secondly, the magnitude of effect is found to depend on the length of the time interval over which it operates.

Thirdly, distinctions between total effect, direct effect, and indirect effect are defined by explicit reference to change over time under specified conditions of control. This foundation differs markedly from usual procedures that rely on decomposition of bivariate correlations. Finally, the correspondence is derived between direct, indirect, and total effects defined by reference to change over time and the same concepts defined in cross-sectional path analysis by reference to correlational decompositions.

The discussion of effects is limited, however. There are numerous conditions under which effects might occur that are not distinguished above. For example, one might wish to assess the effect of x on y, given that x exhibits a predetermined pattern of change during the time the effect is to be assessed. Also, one might be interested in the effects of an endogenous variable on y given the feedback from y to that variable is eliminated.

Commentary

A central theme of this chapter and, indeed, of the remainder of this volume, is that differential equations offer important advantages for expression of theory not shared by conventional structural equations. The chief advantages stem from the fact that the differential equations state a hypothesis about the level of each variable at every instant along a continuous time scale. Advantages of this feature have been noted in this chapter and will be illustrated in detail in chapter 4.

Although this is not a review article purporting to present a carefully balanced summary of the advantages and disadvantages of differential equations, a brief summary of important restrictions seems worthwhile. First, all functions in the model must be differentiable with respect to time. This means that there is no easy way to accommodate endogenous categorical variables such as participation in interscholastic sports or academic curriculum, since any changes in such variables are abrupt rather than continuous. Categorical exogenous variables could be included, however. A second shortcoming of the differential equations is that social scientists have little experience with their application. Consequently, technical development of the methodology lags behind developments related to well-known techniques such as multiple regression, factor analysis, or canonical correlation. Thus, for example, sampling theory for parameters of differential equations is not available, ability to estimate complicated nonlinear (including nonadditive) models is limited, and efficient programs such as LISREL are not available to carry out "theory trimming." While these restrictions cannot be overlooked, the advantages of differential equations for a variety of applications to social phenomena seem attractive enough to merit channeling substantial energy into improving the technology of applying differential equations.

CHAPTER 3

METHODOLOGY

This chapter is divided into five sections. The first section describes the sampling procedures. Section two describes methods of data collection. Section three deals with data coding. The fourth section gives operational definitions for all variables used in the present report. Appendix A contains thorough explication of data collection, instrumentation, and coding. Finally, section five discusses analytic methods. Since the differential-equation model and related statistical issues have been examined elsewhere (Hotchkiss 1979a), the discussion of analytic methods is brief.

Sample

During the study, three waves of data were collected from a panel of youth and their parents. The population from which the sample was drawn includes all sophomores in public high schools in Columbus, Ohio for the 1978-1979 school year. Data collection began with sophomores to ensure that the third and last wave of the survey would occur during the youths' important last year of high school. Data collection for time-one occurred during January, February, and March of 1979, time-two data collection occurred about seven to eight months later, in October and November, and wave-three data collection occurred the year after wave-two data collection. The sample is balanced by race (blacks and whites only) and sex. Approximately 149 youth in each race-sex group survived all three waves of of data collection. Table 2 displays the race-sex breakdown of the sample for each wave. The table shows that, depending on race and sex, between 79 and 89 percent of the original sample remained for all three waves. Attrition from wave one to wave two was higher than attrition from wave two to wave three, despite the somewhat longer time interval in the latter case--compare overall retention rate from t_1 to t_2 of .877 to the rate from t_2 to t_3 of .954. The retention rates are fairly high in each race and sex group, lending reasonable confidence that the results are not influenced unduly by error introduced by sample attrition.

While a regional or national sample would be preferable to the Columbus sample, past experience has shown that local samples do provide usable results. The type of analyses proposed here have been carried out on a Fort Wayne, Indiana sample (Kerckhoff 1971), a small Wisconsin city sample (Woelfel and Haller 1971), a Binghamton, New York sample (Rehberg and

TABLE 2

SAMPLE SIZE BY RACE, SEX, AND TIME

Time One

Sex	Race Black	 White	 Total
Female	187	177	364
Male	172	178	350
Total	359	355	714

Time Two

Sex	Race Black	 White	 Total
Female	159	163	322
Male	148	156	304
Total	307	319	626

Time Three

	Race								
	Black			White			Total		
Sex	N	% of t_1	% of t_2	N	% of t_1	% of t_2	N	% of t_1	% of t_2
Female	150	80.2%	94.3%	158	89.3%	96.9%	308	84.6%	95.7%
Male	136	79.1	91.9	153	86.0	98.1	289	82.6	95.1
Total	286	79.7	93.2	311	87.6	97.5	597	83.6	95.4

Rosenthal 1978), and a Columbus, Ohio sample (Curry et al. 1976) with resultsthat do not differ markedly from reports based on national samples. Curry and associates (1976; 1978) present an appendix comparing the distributions of several demographic variables collected in the sample of Columbus public schools to similar variables reported in the 1970 census. Comparisons were made to Columbus (city and SMSA), the region, and the nation. The results showed that the sample data were similar to the census data, although scattered differences were noted.

Also, the present sample has been compared to the Census and to the sample collected by Curry and associates (Hotchkiss and Chiteji 1979: chapter 3). These comparisons reveal a fairly close correspondence between the present sample and the Curry sample. Statistically significant differences between the present sample and the 1970 census were observed for percentage of parents completing high school and the proportion of intact families. A lower percentage of parents in the sample than in the census graduated from high school, and the sample contains a lower percentage of intact families than the census. No significant difference in parental age distributions in the sample and comparable adults in the census were observed, however. The magnitude of the percentage differences between the sample and the census on high school graduation is not large, but the differences in proportion of intact families is substantial. Since a similar discrepancy between the census proportions of intact families and those for the Curry study exists, it was concluded tentatively that the differences reflect, at least in part, a real trend since the 1970 Census. While no local sample can be used to make precise generalizations to the entire nation, it does appear that a Columbus sample can be used with reasonable confidence to provide an approximation.

An official roster of all sophomores in Columbus public schools was secured from the Columbus Board of Education. Names were drawn at random from this list within race and sex categories. As it turned out, the master list was not current so that an oversampling of approximately three to one was necessary in order to obtain the target number of respondents. This fact may have biased the sample somewhat against families who change address frequently. If so, the unrepresentative nature of the sample should be compensated partially by relatively low rates of attrition for time-two and time-three.

Table 3 presents a percentage breakdown of students originally designated to be part of the study. Percentages are shown according to the reasons for nonparticipation. The first column of percentages are calculated as the percentage of participants plus nonparticipants, and the second column shows percentages of nonparticipants. By far the largest category of nonparticipants is comprised of families who could not be contacted by interviewers. The reasons for failure to contact cannot be determined definitely, but inaccurate telephone number is the most immediate cause. Inaccurate numbers could be due to families moving, changed numbers, or mistakes in the records. Although refusals constitute the second largest category of nonparticipants, the percentage of the total number of students selected who refused is not high, 21 percent. Ineligible youth comprise

TABLE 3

DISPOSITION OF STUDENTS DRAWN FROM THE SAMPLE FRAME
TO BE PART OF THE STUDY

Disposition	Percentage of Total	Percentage of Nonparticipants
No contact made with family	33.8	50.2
Family refused	21.2	31.5
Student not eligible	10.0	14.9
Other nonparticipant	2.3	3.5
Family participated	32.7	--
Total	100.0	100.0
	(N=2185)	(N=1471)

the next largest group of nonrespondents. Ineligible youth include those who were not in school at the time of contact, those who were not first-year high school students, and students with learning disabilities. The residual category of nonparticipants includes cases for which one or more prospective respondents repeatedly failed to keep appointments for home visits by the interviewer, and interviews that were terminated by the interviewer or the respondents. It is difficult to surmise the effects of these omissions from the sample. On balance, it is likely that migrants are less likely to be in the sample than in the population, but other consequences cannot be indicated clearly.

Data Collection Procedures

Interviewers were hired to hand carry self-administered questionnaires to respondents' homes. At time one, interviewers made telephone contacts with the mother or female guardian, in most cases, to gain verbal agreement to participate in the study and set an appointment when all respondents would be available together in the home. The interviewer then called on the family at the appointed time with questionnaires for each respondent member of the family--usually the sophomore youth, his/her mother, and father. No youth participated unless at least one parent also participated. These procedures were duplicated as closely as possible at time two and time three.

Interviewers remained in the home until all respondents completed their questionnaires. It is important to emphasize that each respondent completed the questionnaires independently of the other respondents. During the home visits, interviewers were responsible for (1) clarifying instructions on the questionnaires, (2) requesting signatures on a respondent consent form (time one only) and a pay form, (3) checking questionnaires for completeness after respondents were finished, and (4) editing completed questionnaires for usable occupational information. Each respondent family was paid ten dollars each wave in return for participation; it was for this reason that pay forms had to be signed in respondent homes. Upon completion of the home visit, interviewers returned all materials to the field-site headquarters.

Management of the field operation for time-one was done jointly by project staff and a local survey firm, Appropriate Solutions, Incorporated (ASI). Interviewers were recruited from the interviewer roster of ASI and through an open publicity campaign. Interviewers with no experience were given one four-hour training session, and all interviewers were given a four-hour briefing session informing them of the procedures specific to the study. Time-two and time-three data collection were subcontracted to ASI.

In addition to the home visit, the Thurstone Test of Mental Alertness was administered to students in their respective high schools. Arrangements for this administration were made through the local school board, but the administration was carried out by project staff.

Data Coding and Quality Checks

College students were hired to code questionnaire responses into numeric scores. The numeric scores were transferred to a specially designed coding form in preparation for keypunching. Most of the coding was fairly routine and needs little explanation here. A 10 percent quality check by permanent staff supervisors was conducted routinely. Two members of the project staff assumed responsibility for coder supervision and management during most of time-one coding, and one staff member did so during time two and time three. Coders worked under continual supervision of the coding supervisor.

Two aspects of coding require some explanation. The data set contains subjective probabilities for a list of some ninety occupational categories, twelve income ranges, nine schooling levels, and several categories of vocational training, as described, in part, in the section on definition of variables. Respondents placed checkmarks on continuous lines to indicate their judgments about the chance of entering each occupation, completing each schooling level, and so forth. These checks were measured on a 100 point scale with a specially constructed ruler, to permit empirical analysis of the maximum degree of precision obtainable from respondents.

Occupational coding is the second important type of operation requiring special explanation. Several questions in the surveys requested respondents to name an occupation and list the duties. For example, parents were asked to name their current occupations, and youth were asked for occupational aspirations and expectations. The format of these questions approximates that of the 1970 census, and all these responses were coded into 1970 three-digit census codes. After some trial and error, during time-one coding, procedures similar to census procedures for occupational coding were adopted, and a few coders were selected on merit to specialize in occupational coding. The occupational coding was monitored carefully during the early stages of time one to ensure agreement between the coding supervisor, project director and coders. Standard 10 percent quality checks were maintained throughout. Similar procedures were carried through wave-two and wave-three data coding, except the project director's participation was minimal. Error rates for all three waves were approximately constant at 1 percent.

After coding was completed and the data were keypunched, a new group of student coders was hired to assist in checking accuracy. A computer program was written to check each variable on each case for numerical values beyond the valid range. The student workers corrected values found to be out of range by the computer program. Also, all variables were checked for coding accuracy on approximately 10 percent of the sample. Error rates ranged from .36 percent to 1.7 percent over the three waves of the study. The reader is referred to Appendix A for complete description of data collection, instrumentation, and coding.

Definition of Variables

A total of twenty-six variables is used in this report. All variables except measured mental ability were measured by questionnaires administered as described earlier. The questionnaires are reproduced in Appendix B. The presentation in this section is subdivided into two parts. The first part describes the method of subjective probabilities for measuring career expectations. The second part describes each of the twenty-six variables, referencing the questionnaire item(s) used to construct each variable.

Subjective Probabilities

In this report the term career expectation is used to denote an educational, occupational, or income attainment that one thinks is a realistic possibility. This usage follows Lewin and colleagues (1944) and Kuvlesky and Bealer (1966) but deviates from Haller's (1968) proposal that expectation be reserved for reference to significant other's (SO) attitudes about ego, and aspiration be used to designate ego's attitudes about self. An important reason for preference in this volume for applying the term expectation to SO and to ego is connected to the subjective-probability method of measurement, as will be described presently.

Six variables were measured using subjective probabilities: youth's educational, occupational, and income expectations for themselves, and parents' educational, occupational, and income expectations of their children. Respondents were asked to indicate their subjective judgments of the chance for entry into each of over ninety occupational groups, stop schooling after each of nine levels of schooling, and achieve each of twelve listed income ranges. The instructions in somewhat abbreviated form and one example of occupation, education, and income are reproduced below:

> OCCUPATIONS:
>
> The next few pages contain a list of jobs with a line to the right of each job. We want you to use the line to guess the chance that each job will be your (son's or daughter's) main job for most of your (his/her) life.
>
> a. Put one check on each line.
> b. Place the check so that the farther to the right it is, the higher the chance that this occupation will be your (his/her) main job.

Architect 0 |————|————|————|————| 100

EDUCATION:

Different levels of schooling are listed below next to measuring lines. Please rate the chance that you (your child) will stop regular schooling after completing each level.

a. Place one check on each line.
b. Place the check so that the farther to the right it is, the higher you think the chance that this is the most education you (your child) will get.

College Senior

INCOME:

Different income ranges are listed below next to lines. Please rate the chance that each of the income ranges includes the highest total yearly income ... you (your child) will ever make. Assume the VALUE OF THE DOLLAR DOESN'T CHANGE.

a. Put one check on each line.
b. Place the check so that the farther to the right it is, the higher your (child's) chance that this will be the most you (he/she) will ever make.

$15,000 - $19,999

Entries on these lines are considered to be subjective probabilities. Words in parentheses refer to content for parents' questionnaires. The full content of each type of question is reproduced in Appendix B. (See forms 1, 3, and 6; questions 1, 2, and 3.)

It is assumed that the occupations form a mutually exclusive, exhaustive list of occupations, and that the educational levels are mutually exclusive and exhaustive of "regular" schooling (regular as opposed to vocational training, for example). The income ranges are mutually exclusive and exhaustive by definition. For each respondent and each variable, the subjective probabilities are normed to add up to 1.0. This norming is justified by the assumption that occupational, educational, and income categories are each mutually exclusive and exhaustive among themselves. That the norming can be justified is one of the useful features of the subjective probabilities. Frequently, respondents are asked to indicate responses of the type "very low" to "very high," leaving the metric for each respondent to define. The norming operation converts to a standard metric between respondents.

The educational, occupational, and income expectation variables based on subjective probabilities are defined by the sums of products of the subjective probabilities with the scale values of education, occupation, or income. Suppose y_j is the scale value for education (e.g., 10 indicating tenth grade) or for occupation (e.g., the Duncan SEI for lawyer), or for income (e.g., $17,500). Denote the subjective probability of respondent i for response alternative j by p_{ij}, and assume there are J educational, occupational, or income levels. The score for respondent i for educational, occupational, or income expectation is then defined by

$$x_i = \sum_{j}^{J} p_{ij} y_j$$

where x_i is the score for respondent i. Note that this is an expected value as defined in statistics, and that fact is one reason for preference for the term expectation rather than aspiration.

The subjective-probability measurements were designed especially to account for the fact that teenage youth frequently are uncertain about their future careers. Consequently, in conceptualizing the measurements, particular attention was paid to information that the subjective probabilities provide about the level of uncertainty (Hotchkiss 1979b). For occupations, two types of indexes of uncertainty are proposed: (a) general uncertainty, and (b) uncertainty specific to a given occupational dimension. Analogous concepts apply to education and income, but they are most clearly explicated by reference to occupation. A brief review is presented here as background for the theoretical extension involving uncertainty contained in chapter 5.

To motivate the need for two types of uncertainty measures, consider a hypothetical case of a young girl who expects to be a doctor, a nurse, or a medical secretary and thinks there is no chance she will enter any other occupation. Suppose she estimates one-third as her subjective probability of entry into each of these occupations (and zero for all the rest). Since doctor, nurse, and secretary span a wide prestige range, this girl's prestige-specific uncertainty is high. In contrast, her uncertainty in general is low, since she has narrowed her expectation to only three choices.

The index of general uncertainty can be developed as the sum of uncertainties for each occupation. For a given person and occupation, a subjective probability near one or zero reflects high certainty that the occupation will or will not, respectively, be entered. Conversely, the closer a subjective probability is to one-half, the higher the uncertainty. For a given occupation, then, the product of the subjective probability with its complement is a good index of uncertainty, i.e., $p_{ij} (1 - p_{ij})$. When this product is zero, there is no uncertainty regarding occupation j; either the respondent is sure not to enter the occupation ($p_{ij} = 0$) or is sure to enter it ($1 - p_{ij} = 0$). The product is maximum at $p_{ij} = .5$. The sum of these products over all occupations forms a useful measure of general uncertainty:

$$U_i = \sum_j p_{ij}(1 - p_{ij}) = 1 - \sum_j p_{ij}^2$$

where U_i designates general uncertainty for person i.

This statistic has two desirable properties for defining general uncertainty. It can be shown mathematiclly that: (a) the minimum value of $U_i = 0$ and occurs if and only if the person checks a subjective probability of one for one occupation and zero for all the rest, and (b) the maximum value of $U_i = 1 - 1/J$, where J is the number of occupations. This maximum occurs if, and only if, the respondent's subjective probabilities are the same for all occupations. These two properties nicely reflect one's intuitive meaning of uncertainty. Persons who know exactly what occupation they will enter get an uncertainty score of zero, and persons who think that they are about as likely to enter one occupation as another get the maximum uncertainty score. (It is, perhaps, worth noting that the maximum uncertainty score approaches one as the number of occupations increases.)

A variance provides a convenient summary of specific uncertainty for particular dimensions of occupations. Using socioeconomic status as an example, suppose that numerical scores were assigned to each occupation indicating the status level of the occupation. The variance of the status scores for each respondent reflects the degree of uncertainty regarding the occupational status level that the respondent expects to achieve. In symbols,

$$U_i(s) = \sum_j p_{ij}(y_j - \bar{y}_i)^2$$

where p_{ij} is the subjective probability of person i for entering occupation j, as before, y_j is the status score for occupation j, $\bar{y}_i = \sum p_{ij}y_j$ = the status level of occupational expectation for person i, and $U_i(s)$ designates the level of uncertainty for person i regarding the occupational status level that person expects to achieve.

The measure of specific uncertainty, $U_i(s)$, can be applied generally for any dimension of occupations, e.g., power, income, social approval for female incumbents, and degree of service to society.

Specific Variables

There are twenty-six conceptual variables, but twenty-two of these are viewed aschanging over time and have been measured at three different time points, thus generating a total of 4 + 3x22 = 70 variables. Only twenty-six are described, however, since measurement procedures were essentially identical at all three waves of data collection. A mnemonic abbreviation is associated with most of the variables. To provide a quick reference, the mnemonic for each variable is listed below, accompanied by a brief definition. More complete definitions and presentation of operational procedures are given in later paragraphs.

Exogenous variables (measured once):

1. SEB -- socioeconomic background, (parental socioeconomic status)
2. MA -- measured mental ability

Endogenous variables (measured three times):

3. AP -- academic performance of youth (self report)
4. EEP(SP) -- educational expectation of parents for their child, measured by subjective probability
5. EEP(CL) -- educational expectation of parents for their child, measured by checklist method
6. EEP(AVE) -- the average of EEP(SP) and EEP(CL)
7. OEP(SP) -- occupational expectation of parents for their child, measured by subjective probability
8. OEP(OAS) -- occupational expectation of parents for their child, measured by the Occupational Aspiration Scale (OAS)
9. OEP(AVE) -- average of OEP(SP) and OEP(OAS)
10. EE(SP) -- youth's educational expectation for self, measured by subjective probability
11. EE(CL) -- youth's educational expectation for self, measured by checklist method
12. EE(AVE) -- average of EE(SP) and EE(CL)
13. OE(SP) -- youth's occupational expectation, measured by subjective probabilities
14. OE(OAS) -- youth's occupational expectation, measured by the OAS
15. OE(AVE) -- average of OE(SP) AND OE(OAS)
16. IEP(SP) -- income expectation of parents for their child, measured by subjective probability
17. IEP(CL) -- income expectation of parents for their child, measured by checklist method
18. IE(SP) -- youth's income expectation for self, measured by subjective probability
19. IE(CL) -- youth's income expectation for self, measured by checklist method
20. PEEE -- peers' educational expectation of ego, as perceived by ego
21. PEEP -- peers' educational expectation for peer, as perceived by ego
22. PCP -- peers' college plans, as perceived by ego
23. POEE -- peers' occupational expectation for ego, as perceived by ego
24. POEP -- peers' occupational expectation for peer, as perceived by ego

Control variables (measured once):

25. RACE -- race of the youth
26. SEX -- sex of the youth

The remaining paragraphs of this section contain full definitions and description of operational procedures used to generate numerical values for each of the above variables. In these definitions, the term data-present average is used to describe procedures. Data-present average means to calculate the arithmetic mean of all values not coded as missing data. References to form and question numbers indicate the questionnaire form number and item number. Exact wording of items can be found by reference to the indicated form and question in Appendix B.

SEB stands for socioeconomic status of the youth's parents (socioeconomic background). It was calculated as a data-present average of the standard scores for father's occupational status, mother's occupational status, mother's education, and father's education, averaged across time one and time two. Occupational status for mothers not in the labor force was treated as missing data. Standard scores rather than raw scores were used, to adjust for differences of metric between education and occupation. The primary data source for determining father's occupation, mother's occupation, mother's education, and father's education is the mother's or father's report, time one and time two. When parent's report was missing, the youth's report on the parent was substituted. The occupational question for the father is form 6, question 32; for the mother it is form 4, question 32. The educational question for the mother and father is form 4 and 6, respectively, question 29. The youth's report of father's and mother's occupation is form 2, questions 45 and 46, respectively. The youth's report of mother's and father's education was recorded in form 2, question 44. All open-ended occupational data were coded to three digit 1970 census codes and then translated into Duncan SEI codes by reference to Appendix B in Hauser and Featherman (1977).

MA denotes measured mental ability. It was measured by the Thurstone Test of Mental Alertness in a special administration in each students' high school. The Thurstone Test generates three scores, a verbal, quantitative, and total score. The total score was used to define MA. Due to the fact that the tests were administered in late spring of 1979, the school year ended before all makeup sessions could be completed. As a consequence, after wave one and wave two there was a substantial quantity of missing data for MA: 102 out of 159 (64.2 percent) of the black females took the test, 118 of 163 (72.4 percent) white females, 107 of 148 (72.3 percent) black males, and 103 of 156 (66.0 percent) white males took the test. The Thurstone Test was selected primarily because it requires a short period to take, twenty minutes. The short administration time facilitated scheduling.

AP stands for academic performance. The measure used in this report is derived from students' responses to a question about how good a student they felt they were. Responses were converted to a four-point scale equivalent (with a maximum of four and minimum of zero). It should be emphasized that the operational definition of AP used here involves the idea of academic self concept; it is not a self-report estimating the calculated grade-point average. The AP variable here thus differs somewhat from usual practice. Also, the question refers to major subjects, thus excluding by implication courses such as music, art, and physical education. Although there is some room for differences of interpretation among respondents on this question, such differences probably are not substantial due to the fact that three major subjects are listed as examples in the question (see form 2, item 40).

EEP(SP) is the parents' educational expectation of their child based on subjective probability. It is a data-present average of mother's and father's educational expectation of the youth based on subjective probability, as reported by the parents. There are nine values of y--10 for tenth grade through 18 for Ph.D. or professional degree (see forms 3 and 5, question 3).

EEP(CL) is the parents' educational expectation of their child based on a standard questionnaire item for which parents were asked to check from a list the level of education their child most likely would achieve. The composite variable for the parents is a data-present average of the mother's and father's responses. The same nine levels of education used in the subjective-probability measurements were used in the checklist method (see forms 4 and 6, question 6).

EEP(AVE) is a data-present average of the previous two variables, EEP(SP) and EEP(CL).

OEP(SP) is the parents' occupational expectation of their child based on subjective probability. It is a data-present average of mother's and father's occupational expectation of the youth based on subjective probability, as reported by the parents. There are ninety-three values of y for the occupation variables at time one; the number of occupational categories was expanded to ninety-seven for time two and time three. Each occupation on the list represents one or more of the occupations contained in the three-digit 1970 census categories. Duncan SEI scores were assigned to each occupation category by averaging Duncan SEI's associated with census categories represented by each occupation category. Due to an oversight, a few of the three-digit census categories are not represented in the question for time one. Strictly speaking, therefore, the assumption of exhaustiveness is not met, but it was assumed that the violation is not serious. Also, the assumption of mutual exclusivity of the occupation groups for time one was violated in one instance because the stimulus "engineer" appears once in isolation and once in a group of technical occupations. A correction was carried out by subtracting each respondents' subjective probability for engineer from the subjective probability for the second category including engineer and other occupations. This difference is treated as the subjective probability of entry into the nonengineering occupations listed in the category including engineers and other occupations. If the difference were negative, it was set to zero. (See forms 3 and 5, question 1.)

OEP(OAS) is the parents' occupational expectation of their child derived from the Occupational Aspiration Scale (OAS) (Haller and Miller 1971). It is a data-present average of mother's and father's responses. (See forms 4 and 6, questions 20 through 27.)

OEP(AVE) is a data-present average of the previous two variables, OEP(SP) AND OEP(OAS).

EE(SP) stands for educational expectation of youth based on subjective probability. It is the youth's expectation for self; otherwise, it is defined in the same manner as the educational expectation based on subjective probability of each parent for the youth (see form 1, question 3).

EE(CL) is the youth's educational expectation for self based on a standard questionnaire item for which students were asked to check from a list the level of education they most likely would achieve. The same educational categories used for parents were used for youth. (See form 2, question 3.)

EE(AVE) is a data-present average of the previous two variables, EE(SP) and EE(CL).

OE(SP) stands for occupational expectation of youth based on subjective probability. It is the youth's expectation for self; otherwise, it is defined just as is each parent's occupational expectation of the youth based on subjective probability (see form 1, question 1).

OE(OAS) stands for occupational expectation of youth derived from the Occupational Aspiration Scale (OAS) (Haller and Miller 1971). (See form 2, questions 19 through 26.)

OE(AVE) is a data-present average of the previous two variables, OE(SP) and OE(OAS).

IEP(SP) is the parents' income expectation of their child based on subjective probability. It is a data-present average of mother's and father's responses. The midpoints of twelve income ranges for each item were assigned as item scores, except 50,000 dollars was assumed arbitrarily for the highest income category. (See forms 3 and 5, question 2.)

IEP(CL) is the parents' income expectation of their child based on a questionnaire item for which parents were asked to check from a list the income range their child most likely would achieve. The composite variable for the parents is a data-present average of the mother's and father's responses. The same income ranges used for the subjective-probability method also were used for this checklist. (See forms 4 and 6, question 18.)

IE(SP) is the youth's income expectation for self based on subjective probability. The midpoints of twelve income ranges for each item were assigned as item scores, except 50,000 dollars was assumed arbitrarily for the highest income category. (See form 1, question 2.)

IE(CL) is the youth's income expectation for self based on a questionnaire item for which students were asked to check from a list the income range they most likely would attain. The same twelve income ranges used for the subjective-probability item and for parents were used for this question (see form 2, question 15).

PEEE is the educational level that students believe their peers think the student (ego) will achieve. The item is a checklist item parallel to EE(CL) and EEP(CL), except that ego rather than the significant other answers the question. This item would be classified as a variable intended to assess the "definer" influence of peers. (See form 2, question 33.)

PEEP is the educational level that students (ego) think their peers will achieve. The item is a checklist item parallel to other education items. It would be classified as a variable intended to assess the "modeler" influence of peers. (See form 2, question 37.)

PCP stands for peer college plans. The variable is defined by the percentage of students' peers they think will go to college. (See form 2, item 36.)

POEE is the occupational status level students think their peers might expect the youth (ego) to achieve. The question is an open-ended item; responses were coded into 1970 census three-digit occupations and then converted to Duncan SEI scores. (See form 2, question 34.)

POEP is the occupational status that students (ego) think their peers will achieve. The question uses an open-ended format; responses were coded into 1970 census three-digit occupations then converted into Duncan SEI scores (see form 2, item 38).

RACE stands for the race of the youth. The primary data source for RACE was an item completed by the student at time one. This response was checked against the records on the school roster used to define the population. Discrepant cases were resolved by asking interviewers to state the race of the student.

SEX stands for the sex of the youth. The primary data source for SEX was an item completed by the youth at time one. Accuracy of sex codes were checked in the same way those for race were checked.

In recent publications related to status attainment it is unusual to find aggregate measures of SEB. For this report, there are several reasons why the aggregate measure is preferable to separate study of the SEB components. First, the aggregate variable is more parsimonious than separate variables; fewer coefficients must be examined. The purposes at hand are not to investigate the relative importance of the different SEB components on career expectations. Secondly, sampling accuracy is higher (i.e., standard errors are smaller) because fewer degrees of freedom are lost than when SEB components are studied separately. Thirdly, past experience indicates that the magnitude of path coefficients not involving SEB variables is changed little by disaggregation of SEB into its components (Curry et al. 1978). Finally, the SEB components are intercorrelated to a fairly high degree, thus studying separate SEB components introduces collinearity into the matrix of correlations among regressors, thereby increasing sampling instability.

The aggregate parental significant-other variables (e.g., EEP) can be justified on similar grounds. The educational and occupational expectations of the mother for her child are highly correlated with those of the father. Thus, disaggregation of mother's and father's career expectations of their child would produce multicollinearity. Secondly, disaggregation of parents' career expectations implies that analyses be confined to intact families in which both parents participated in the survey, thus substantially reducing sample size. Finally, the parsimony of the aggregate parental expectation variables is appealing.

The operational definitions of occupational variables make it clear that all occupation variables measure socioeconomic components of occupations. Other content of occupations is ignored. This is a potentially serious shortcoming of sociological theory of occupational attainment, but it is one which this report is not designed to address. (See Spaeth [1979] for a recent review of these issues and theoretical proposal regarding occupational dimensions.)

Data Analysis

Detailed expositions of the data analysis method for this study are already in print (Hotchkiss 1979a; Hotchkiss and Chiteji 1979: chapter 4); hence, this section is fairly brief. It summarizes the earlier work. The presentation is divided into two subsections. The first subsection reviews the method of estimating the unknown constants in the theoretical model. Subsection two describes the method of generating forecasts and statistical summaries for evaluating them.

Estimation

It is central to the methodological philosophy of this study that no information about wave-three data be used to help estimate the parameters of the model. Thus, all estimation was done with wave-one and wave-two data as input.[17] Since it was not possible to identify those who drop out of the sample between wave two and wave three before wave-three data were collected, those who did drop out during that time interval were included in the sample from which the parameters were estimated. On the other hand, those dropping out between time one and time two could be identified prior to time three, so they were excluded from the estimation. In sum, all those who were present for both wave one and wave two were included in the samples from which the models were estimated, and forecast accuracy was evaluated with the sample of respondents who were present in all three waves.[18]

---

[17] After checking forecast accuracy, of course, it might be useful to improve estimates of parameters or estimate alternative specifications using wave-three data. Such procedures should be interpreted as a way to generate hypotheses rather than test them, however. Resource constraints on the present study preclude extensive use of wave-three data for purposes other than checking forecast accuracy. In particular, wave-three data could be used to estimate a distributed-lag model that might yield some useful insights.

When the final goal of statistical calculations is to estimate unknown parameters of a model, it is unnecessary to fill in estimates for missing observations. The estimation can proceed on the basis of covariances or correlations calculated from pairwise-present cases (Kmenta 1971: 341-344). To generate a forecast, however, serious bias in a forecast value would be introduced if calculation of the forecasted value simply skipped over missing observations. Some bias, though not as severe, would result if means were substituted for missing observations. For the present analysis, regression estimates were calculated (using only wave-one and wave-two data) for each missing observation. A data set was created including these estimates of missing observations, and both the estimation and calculation of forecast values were done with these data.

The main estimation strategy used in this report is to apply ordinary least squares (OLS) to equation (4) and use equations (5) to calculate estimates of the fundamental parameters of the differential-equation system. For the reader's convenience, equation (4) (chapter 2) is reproduced here as (19) and equations (5) written as equations (20):

$$\underline{y}_t = \underline{A}^*\underline{x} + \underline{B}^*\underline{y}_0 + \underline{u}_t \qquad (19)$$

where

$\underline{y}_t$ = a column vector of endogenous variables measured at time t, in this case, time 2 measurements

$\underline{y}_0$ = a column vector of endogenous variables at time 0

$\underline{x}$ = a vector of exogenous variables

$\underline{u}_t$ = a vector of unmeasured disturbances at time t

$\underline{A}^*$ = a coefficient matrix associated with the exogenous variables

$\underline{B}^*$ = a coefficient matrix associated with the time-zero endogenous variables

---

[18] No respondents who failed to complete wave-two questionnaires were contacted for wave three.

To find the coefficients of the differential equation [$d\underline{y}/dt = \underline{Ax} + \underline{By} + \underline{u}$], the following formulae apply:

(20a) $\underline{A} = \underline{B}(e^{\underline{B}t} - \underline{I})^{-1}\underline{A}^*$

(20b) $\underline{B} = (\ln \underline{B}^*)/t$

The matrix $\underline{A}^*$ gives the accumulation of effects of the exogenous variables on the endogenous variables over the finite time interval from time-one to time-two. The matrix $\underline{B}^*$ is the matrix of cross-lagged regression coefficients and contains estimates of the total effects of the endogenous variables on each other over the same finite time interval (see chapter 2). The magnitude of the entries in the matrices of instantaneous effects, $\underline{A}$ and $\underline{B}$ can be adjusted by choice of time scale. The relative magnitudes are independent of the time scale, however. Dependence of $\underline{A}$ and $\underline{B}$ on the time unit can be seen readily by inspection of formulae (20). For this report, six months is the unit-length time interval. This selection was made arbitrarily for the sake of convenience; it generates entries in $\underline{A}$ and $\underline{B}$ that approximate the magnitudes of the familiar standardized regression coefficients.

To facilitate comparisons among coefficients in the model, a somewhat unorthodox standardization procedure was applied to the variables. The exogenous variables were standardized by subtracting a population estimate of the combined mean of all four subgroups from each raw numerical score and dividing the result by a sample estimate of the overall standard deviation. In path analysis this procedure, when applied to *all* variables. produces "standardized path-regression coefficients." These coefficients can be compared between subgroups and between variables (Hotchkiss 1976). A similar procedure was applied to the endogenous variables, except that the time-one means and standard deviations were used to standardize measures at all three times. Use of time-one values as standardization constants avoids removal of changes in mean and variability from the data (see Hotchkiss 1979a). The usefulness of the standardized coefficients is clear, but it is important to avoid the temptation to overinterpret them, especially in a preliminary report such as the present work.

The literature on structural equations is replete with warnings against indiscriminant application of OLS, especially when time series or panel data are to be analyzed (e.g., Fisher 1976; Koopmans, Rubin, and Leipnik 1950; Koopmans 1953; Goldberger 1964). Two key points emerge from this literature. First, consistent estimation with OLS demands that all regressors be uncorrelated with the disturbance variables. In the present case, this means that $\underline{x}$ and $\underline{y}_0$ are uncorrelated with $\underline{u}_t^*$. Secondly, use of statistics depending on the variance of $\underline{u}^*$, such as statistical tests and R-squares, require that $\underline{u}_t^*$ be distributed independently of $\underline{x}$ and $\underline{y}_0$.

The major threat to these assumptions in the analysis of panel data consisting of two time points is the likely presence of autocorrelation among the disturbances (see Markus 1979, Johnston 1972, or Hannan and Tuma 1979). Tests for autocorrelation in time-series data are available

(Johnston 1972), but such tests do not apply to panel data with only three time points.

While sample disturbances from OLS necessarily are uncorrelated with the regressors, this is not true of the errors of forecasting. The correlations of forecasting errors with regressors were calculated for the basic model reported in chapter 4, thus giving a weak test of the assumption that regressors are not correlated with disturbances. These correlations are uniformly small to moderate in magnitude. As expected, these correlations are highest where lagged endogenous variables are the regressors (.20--.35). This analysis of correlations involving disturbances, then, gives some credence that the assumptions required by OLS are not violated to a critical extent, but the results show need for further investigation of appropriate estimation methods.[19]

Statistical tests of significance are not reported in this volume. The main focus of interest is on statistics such as the matrices of the differential equation, $\underline{A}$ and $\underline{B}$, or on equilibrium effects, and on forecasting summaries. Standard output of statistical packages do not produce standard error estimates for such statistics, though standard errors of $\underline{A}$ and $\underline{B}$ would be useful in view of circumstantial evidence in the authors' experience that sample estimates exhibit rather high sampling variability (see also Doreian and Hummon 1979).

An approximation to the variance of the coefficients of the differential equations could probably be constructed from a formula given by Kmenta (1971: 444). Application of the approximation would be a useful step in future work with these data.

Forecasting

The forecasts of time-three endogenous variables were carried out by substituting the appropriate value of t into the inverse of equations (20), i.e.,

$$\underline{A}^* = (e^{\underline{B}t}-\underline{I})\underline{B}^{-1}\underline{A}$$

$$\underline{B}^* = e^{\underline{B}t}$$

and substituting the result into equation (19). This step is necessary because the time lapse between the wave-one and wave-two data is different than the length of time between wave two and wave three. Thus, one cannot simply apply the regression coefficients directly. Two sets of forecasts

---

19. Some experimenting with the LISREL IV computer program was conducted in an effort to obtain alternative estimates of $\underline{A}^*$ and $\underline{B}^*$. The results were not satisfactory, but further experimenting may produce more useful outcomes.

were generated, one using time-one values of the endogenous variables as inputs and one using time-two values as inputs. Although these two sets of forecasts are highly correlated, they are not identical. As one might expect, data reported in chapter 4 shows that more accurate forecasts occur when time-two than when time-one data comprise the inputs.

To evaluate the accuracy of the forecasts it is essential to have some summary statistic. Because of the pervasive use of R-squares in the social and behavioral sciences, a generalized R-square is a useful summary. Although there are alternative summaries of goodness of fit that are superior to R-square, R-squares are reported in this volume to preserve comparability with past work.

As preparation for defining goodness-of-fit measures to assess the accuracy of forecasts, it is useful to review the interpretation of R-square as a proportional-reduction-of-error (PRE) measure. Let

$$y = p_0 + \sum_{j=1}^{K} p_j z_j + v$$

where y is the dependent variable, the z_j are K independent variables, v is the error, and the ps are constants. The following formula for R-square offers considerable heuristic appeal:

$$(21) \quad R^2 = 1 - s_v^2/s_y^2$$

where R^2 denotes the square of the multiple correlation (R-square), and s_v^2, s_y^2 indicate the variance of v and of y, respectively. The OLS estimates of the ps ensure that the mean of $v = y - y^*$ is zero, where y^* is the value of y predicted from the regression equation. Hence, s_v^2 is a variance of the errors of prediction from the linear regression:

$s_v^2 = E(y - y^*)^2$, where E denotes expected value.

The denominator of the ratio in equation (3) is the variance of the dependent variable:

$$s_y^2 = E(y - Ey)^2$$

This variance can be interpreted as a measure of error in the absence of information about the independent variables, where the mean of y (Ey) is used as a constant predicting the entire set of y values. Recall that, in fact, the mean of y is the best constant predictor of all ys, in the sense that the mean-square-error is minimized when the constant is the mean of the distribution.[20]

With this background, it is clear that the ratio s_v^2/s_y^2 is a ratio of mean-square errors--the numerator summarizing prediction errors from the regression equation, and the denominator summarizing prediction errors when all values of y are predicted to be the mean of y. Hence s_v^2/s_y^2 can be viewed as a PRE measure and, ipso facto , so can $R^2 = 1 - s_v^2/s_y^2$. When OLS estimates of the ps are used, the minimum R-square is zero and its maximum is one.

A straightforward generalization of (3) provides a useful statistic for summarizing the accuracy of forecasts. Define

$$(22) \quad R^2_{Fc} = 1 - MSE/s_t^2$$

where R^2_{Fc} denotes an R-square for forecasts, MSE stands for mean-square error, and s_t^2 is the variance of the predicted endogenous variable at time t:

$$MSE = E(y_t - \hat{y}_t)^2$$

$$s_t^2 = E(y_t - Ey_t)^2$$

where $\hat{y}_t$ is the forecasted value of the scalar y_t. It is important to distinguish $\hat{y}$, the forecasted y, from y*, the post facto estimated value of y from a regression analysis. The forecasted y_t is a value of y that is predicted prior to observing y. In contrast, the regression y* can only be calculated after the values of y are observed, because each observed y is necessary in order to calculate the regression coefficients. Note that, in general $E(y_t - \hat{y}_t) \neq 0$; therefore, MSE will not be a variance as it is in multiple regression.

The maximum value of R^2_{Fc} is 1.0 and occurs if and only if forecasts of y are correct for every observation. On the other hand, the minimum R^2_{Fc}

---

[20] Let p_0 be a constant over the y values and form the mean-square-error--$MSE = E(y - p_0)^2$. Differentiating with respect to p_0, setting to zero and solving yields, $p_0 = Ey$. The second derivative of MSE with respect to p_0 is the positive constant, 2.0. Hence, a necessary and sufficient condition for a minimum is present when $p_0 = Ey$. Alternatively, one might postulate p_0 =, $Ey + q$ = any constant, and develop the following argument:

$$E(y - Ey + q)^2 = E(y - Ey)^2 + q^2$$

Clearly, this expression is minimum if and only if $q = 0$, so that $p_0 = Ey$.

is not zero; R^2_{Fc} may be negative (indicating R^2_{Fc} should be interpreted as an imaginary number). When used in conjunction with non OLS regression estimates, R-square may also be negative, and it has been objected to on these grounds (Fox 1978: 145; Basmann 1962). The fact that R^2_{Fc} may be negative, however, is not a strong objection, since a negative R^2_{Fc} has a straightforward interpretation; the negative value indicates that more accurate estimates of all ys result when each y is estimated to be the mean of y than when the ys are forecast from the model.

Numerous alternatives to (21) are available (see Fox 1978; Ostrom 1978). Of those proposed, one seems particularly appealing. Ostrom (1978: 67) proposes that s^2_t in (21) be replaced by the mean-square of the differences between t_0 and t_1 values of y. The implicit hypothesis of this mean-square-error is that the y values do not change; a stable equilibrium has been reached. The resulting measure retains its PRE characteristics, since it is based on a ratio of a MSE due to the model to a MSE derived from a "naive" model. A more general definition of R^2_{Fc} is therefore suggested (see Ostrom 1978: 68):

$$R^2_{Fc} = 1 - \frac{MSE(M)}{MSE(N)}$$

where MSE(M) is the mean-square error for the theoretical model and MSE(N) is the mean-square error for a "naive" model (naive is Ostrom's term). One important advantage of defining MSE(N) = s^2_t, as in (3), is that R^2_{Fc} is more readily compared to regression R-square than with other definitions of MSE(N); nevertheless, a variety of MSE(N) might prove useful, depending on the circumstances. In this report, a naive model of no change and a single-equation model are used, in addition to formula (22).

Reliance on the bivariate correlation between y and $\hat{y}$ to assess forecast accuracy should be used with caution (Fox 1978). With OLS regression, this bivariate correlation is the same as the multiple correlation, but this equivalence does not generalize to R^2_{Fc}. The difficulty with the correlation between and y is that it presumes that two regression constants, in addition to the parameters of the model, are utilized to make the predictions. Thus, systematic error in the forecasts could easily be masked by the correlation between y and $\hat{y}$. It is theoretically possible that the R^2_{Fc} is negative even when the bivariate correlation between y and $\hat{y}$ is high. If this fact is recognized, however, the correlation might be used in conjunction with R_{Fc} to assess the degree to which forecasting errors are systematic.

The distinction between R-square (from OLS) and R_{Fc}-square calculated to assess the accuracy of forecasts is of fundamental importance in the assessment of theory. A regression R-square assesses accuracy derived from a model for which the parameters are determined post facto according to the explicit criterion of maximizing R-square. R-square cannot be calculated until after the dependent variable is observed and incorporated into calculation of the regression coefficients. In contrast, R_{FC}-square calculated from forecasts assesses prediction in the strict meaning of the term, because the forecasts are made prior to observing the endogenous variables at the time point for which predictions are targeted. The values of the dependent variable at the target date of the prediction do not enter into calculation of the prediction equation. One may conclude, therefore, that forecasts comprise a much stronger test of theory than regression studies. This interpretation is reflected by the range of R-square due to OLS compared to the range of R_{FC}-square from forecasts.

CHAPTER 4

EMPIRICAL RESULTS

This chapter presents the findings of the study. The focus is on the theoretical processes over time and the adequacy with which the model describes those processes. Because this study introduces a new theoretical model to describe processes of career development and proposes an unusual method of testing theory by use of forecasts, the results necessarily are tentative. Nevertheless, some of the findings are striking and open excitingpossibilities for further investigation by extending the theoretical model. Although some of the most interesting extensions require highly technical development of computer methods, in principle the required development is feasible.

The Basic Model

The specific model to be estimated in this chapter is stated mathematically in equation-system (2). This equation system is reproduced here as equation (23), for the reader's convenience.

(23a) $dAP/dt = a_{10}+a_{11}SEB + a_{12}MA + b_{11}AP + b_{12}EEP + b_{13}OEP + b_{14}EE + b_{15}OE + u_1$

(23b) $dEEP/dt = a_{20}+a_{21}SEB + a_{22}MA + b_{21}AP + b_{22}EEP + b_{23}OEP + b_{24}EE + b_{25}OE + u_2$

(23c) $dOEP/dt = a_{30}+a_{31}SEB + a_{32}MA + b_{31}AP + b_{32}EEP + b_{33}OEP + b_{34}EE + b_{35}OE + u_3$

(23d) $dEE/dt = a_{40}+a_{41}SEB + a_{42}MA + b_{41}AP + b_{42}EEP + b_{43}OEP + b_{44}EE + b_{45}OE + u_4$

(23e) $dOE/dt = a_{50}+a_{51}SEB + a_{52}MA + b_{51}AP + b_{52}EEP + b_{53}OEP + b_{54}EE + b_{55}OE + u_5$

where
SEB = socioeconomic background
MA = mental ability
AP = academic performance
EEP = educational expectation of parents for their child
OEP = occupational expectation of parents for their child
EE = youth's educational expectation for self
OE = youth's occupational expectation for self

There are two exogenous variables and five endogenous variables in the model. The exogenous variables are SEB and MA, and the endogenous variables are AP, EEP, OEP, EE, and OE. In summary, the model states that the instantaneous rates of change over time in the five endogenous variables depend linearly on the exogenous variables and on the current numerical value of the endogenous variables. The model permits all possible feedback loops among the endogenous variables. Thorough examination of alternative theoretical interpretations of the model are contained in chapter 2.

Most path models of career expectations contain more variables than appear in equations (23). In most empirical studies, the SEB variable is disaggregated into its components, in this case, father's occupational status, father's educational achievement, mother's educational achievement, and mother's occupational achievement. Also, investigation of the separate influence of the mother and the father demands disaggregation of the parental-expectation variables (EEP, OEP). Finally, nonparental significant-other variables, such as peer expectations, counselors' advice, and teachers' expectations frequently are of interest.

The simplicity of the model can be justified in part by the fact that this is the first investigation applying a continuous-time dynamic model to development of career expectation. The parsimonious model presented here can serve as a starting point for expansion at a later date. Additionally, the OLS estimation procedure described in the previous chapter appears to be sensitive to sampling variability. Since sampling stability declines with each additional independent variable, it is best to keep the number of independent variables to a minimum until further investigation of statistical methods can be carried out.[21]

Calculations including disaggregate socioeconomic background were carried out, but are not reported in detail here. In summary, the disaggregation had little effect on the pattern of coefficients associated with the endogenous variables, but the coefficients associated with the separate SEB variables were difficult to interpret theoretically.

No calculations were done with mother's educational expectation and occupational expectation treated as distinct from those of the father. There are two reasons. First, such calculations should be carried out separately for youth with both parents living at home and youth living in one-parent households. The sample size within each race-sex subgroup for this study will not support such calculations. Further, in most cases, data were not collected from parents not living in the home. Secondly, mother's expectations of the youth are highly correlated with father's expectations; hence, disaggregating parental expectations would introduce additional multicollinearity among the regressors and thereby decrease sampling stability. The method by which mother's and father's expectations are combined to create EEP and OEP conforms closely to the "additive model" for combining information from significant others (see Webster, Roberts, and Sobieszek 1972).

---

21. The difficulties with various econometric methods are summarized in chapter 3 and developed in detail in Hotchkiss and Chiteji (1979: chapter 4).

Forecasting Accuracy of the Basic Model

For each of the career expectation variables (EEP, OEP, EE, OE) in the model, two measurements are available in the present sample. For educational expectations, method one is derived from subjective probabilities for completing different levels of schooling, and method two depends on the conventional checklist method. Occupational status levels of expectations were measured by subjective probabilities and by the Occupational Aspiration Scale (OAS) (see chapter 3). The quality of these methods is assessed by comparing the accuracy of forecasts that are generated by the model with the different measurements. The assessment is a rigorous form of predictive validation.

The forecasting test is pivotal to the methodological philosophy of this study, yet it is easily confused with tests relying on regression techniques. Consequently, the main ideas behind the forecasting test bear repeating here. Theory testing by forecasts demands that a theoretical model be used to generate predictions of future values of one or more variables in the model. In generating the predictions it is important that the data to be predicted are not used in any way to generate the predictions. It is this feature that distinguishes the forecasts from regression estimates of the dependent variable(s). Standard R-squares produced by regression analysis rely on regression coefficients that cannot be calculated without prior knowledge of all values of the dependent variable(s). In any cross validation, including a forecasting test, at least some and possibly substantial reduction of accuracy over the original regression can be expected. This fact is reflected by the possibility that generalized R-squares applied to assess the accuracy of forecasts could assume negative values.[22]

The reason for insisting on theory testing by forecasts is closely related to the identification issue. Identification of structural coefficients from any given data set always requires imposition of untested assumptions on the estimating equations; ultimately, every model is underidentified (Simon 1979). In contrast, the forecasting test imposes overidentifying restrictions--by definition of a forecast, not all the data can be used to estimate the structural coefficients. The particular form of overidentifying restriction imposed by a forecasting test is especially appealing because forecasting is one of the fundamental goals of science. Further, development of accurate forecasts from theoretical work offers the prospect of practical applications that are not readily available from conventional methods of theory testing. Such application could be an important way to demonstrate accountability to funding agencies at a time when funding for basic research in the social sciences is on the wane.

---

22. Recall that the negative values do have straightforward interpretation and, therefore, ought not generate undue consternation (see chapter 3, p. 53).

The forecasts were generated in two steps. First, the coefficients of the differential equations were estimated using wave-one and wave-two data as input. Secondly, these coefficients were applied to the wave-one and wave-two observations to produce forecasts for each person and each endogenous variable at wave three. These procedures produce two forecasts for each wave-three variable, one when wave-one data are input and one when wave-two data are input. To be entirely explicit, the formulas are reproduced below. In matrix notation, the basic model is

$$d\underline{y}/dt = \underline{Ax} + \underline{By} + \underline{u}$$

as defined in chapter 2, p. 17. Given estimates of the coefficients in $\underline{A}$ and $\underline{B}$, the two forecasts are given by:

Forecast 1: $\hat{\underline{y}}_{3.25} = (e^{3.25\underline{B}} - \underline{I})\underline{B}^{-1}\underline{Ax} + e^{3.25\underline{B}}\,\underline{y}_0$

Forecast 2: $\hat{\underline{y}}_{3.25} = (e^{2\underline{B}} - \underline{I})\underline{B}^{-1}\underline{Ax} + e^{2\underline{B}}\,\underline{y}_{1.25}$

where $\hat{\underline{y}}_{3.25}$ is the forecasted value of $\underline{y}$ after 3.25 time units of six months each has elapsed, $\underline{x}$ is the vector of exogenous variables (1.0, SEB, MA), $\underline{y}_0$ is the vector of endogenous variables (AP, EEP, OEP, EE, OE) at the initial time point, and $\underline{y}_{1.25}$ is the vector of the same variables 1.25 time units later.[23] Since the wave-one and wave-two inputs do not yield the same forecasts, two tests are available.[24]

Four measurement combinations were tried: one relying exclusively on subjective probabilities; one based exclusively on nonsubjective-probability methods; one mixed calculation in which occupational expectations (OEP and OE) were based on subjective probabilities but educational expectations (EEP and EE) were not; and, finally, one in which both educational and occupational expectations were calculated as averages of the subjective-probability and the alternative measurements. The results are reported separately by race and sex in table 4.

The information in table 4 consists of generalized R-squares; they assess the accuracy of forecasts in a way quite analogous to the definition of R-square in regression analysis. In view of the fact that the R-squares for forecasts are not constrained to a minimum value of zero, the fact that all the R-squares are positive is an important observation; there is uniformity in development of career expectations that can be captured by a relatively simple dynamic model. It is clear that the accuracy of the forecasts depends strongly on sex and race and on the measurements. For

---

[23] Recall that wave-one data were collected in the winter of the respondents' sophomore year in school, wave-two data were collected about seven and a half months later in the fall of the junior year, and wave-three data about one year following wave-two data.

[24] Of course, if the disturbance variables were uniformly zero for all respondents and all variables, these forecasts would be the same.

TABLE 4

FORECASTING R-SQUARES: FOUR MEASUREMENT VARIATIONS OF THE BASIC MODEL

Wave-One Forecasts of Wave Three

Endogenous Variables	Measurement Combination															
	Subjective Probability				Nonsubjective Problty				Mixed				Average			
	FB	FW	MB	MW	FB	FW	MB	MW	FB	FW	MB	MW	FB	FW	MB	MW
AP	.153	.342	.250	.384	.111	.314	.259	.365	.140	.328	.259	.385	.164	.318	.261	.380
EEP	.327	.462	.274	.522	.414	.561	.384	.585	.407	.546	.396	.547	.552	.564	.469	.629
OEP	.204	.435	.280	.692	.404	.520	.380	.618	.247	.448	.303	.608	.472	.602	.450	.688
EE	.183	.517	.385	.576	.303	.539	.371	.494	.272	.552	.390	.499	.325	.613	.488	.626
OE	.229	.324	.337	.573	.199	.436	.332	.419	.230	.335	.364	.574	.324	.475	.458	.608

Wave-Two Forecasts of Wave Three

Endogenous Variables	Measurement Combination															
	Subjective Probability				Nonsubjective Problty				Mixed				Average			
	FB	FW	MB	MW	FB	FW	MB	MW	FB	FW	MB	MW	FB	FW	MB	MW
AP	.247	.425	.319	.438	.243	.374	.303	.440	.272	.396	.319	.450	.271	.391	.311	.443
EEP	.357	.530	.433	.594	.445	.564	.438	.688	.441	.599	.476	.697	.567	.611	.585	.756
OEP	.299	.525	.408	.687	.470	.565	.482	.697	.371	.553	.403	.718	.552	.658	.538	.779
EE	.279	.553	.485	.594	.494	.543	.419	.532	.448	.557	.461	.540	.472	.630	.575	.656
OE	.300	.364	.432	.663	.330	.491	.294	.493	.311	.412	.418	.664	.451	.539	.498	.711

NOTES:

1. For the column groups labeled Subjective Probability, both educational and occupational expectations were measured with the subjective-probability method. For the columns labeled Nonsubjective Probability, the checklist method was used for education and the Occupational Aspiration Scale for Occupation. For the columns labeled Mixed, subjective probabilities were used for occupation and the checklist for education. The columns labeled Average refer to measurements calculated as averages of the Subjective Probability and Nonsubjective Probability measures.

2. The column titles are defined as follows: FB = female blacks, FW = female whites, MB = male blacks, and MW = male whites.

3. The mnemonics for the variables are: AP = academic performance, EEP = educational expectation of parents, OEP = occupational expectation of parents, EE = educational expectation (of youth), and OE = occupational expectation (of youth).

male whites, using the averaged expectation variables, the R-squares are remarkably high--exceeding .60 in every case except for academic performance (AP). When the averaged expectation measurements are applied, forecast accuracy also is quite high for female whites and fairly good for blacks of both sexes.

The accuracy of the forecasts exhibits interaction by measurement methodand race-sex group. When both educational and occupational expectation variables are measured by subjective probability, forecast accuracy among whites is comparable to accuracy achieved by the nonsubjective probability methods. On the other hand, among blacks, the nonsubjective-probability methods are clearly superior. Inspection of the R-squares suggests that the reason for this difference may be due to the superior performance of the traditional measure of educational expectation. The mixed measurements in which the traditional education measure was combined with the subjective-probability measure for occupation tends to support this point. The mixed measurements produce forecast accuracy that is quite comparable to accuracy exclusively based on the traditional measures. By a wide margin, the best results occur when the subjective probability and nonsubjective probability measures are averaged. This result, of course, conforms to what one would expect from classical test theory. The remainder of this analysis uses the averaged expectation variables.

The R-squares reported in table 4 indicate how well the model can be applied to data at a given point in time to forecast differences among individuals at a later point in time. The results are so encouraging that one is tempted to conclude that the theoretical model might find useful application in career guidance. Relatively brief paper-and-pencil tests could be administered in early high school and the results used to forecast career expectations at the senior year. Without such forecasts, the implicit assumption in using the paper-and-pencil test is that no change occurs over the high school years. This implicit presumption of no change suggests comparisons between the accuracy of the complex theoretical model and the accuracy of a "naive" model which forecasts quite simply that every variable has the same value at the forecast time point as it did at the beginning of the time interval over which the forecast occurs. As a theoretical comparison, it also is interesting to compare the accuracy of the full theoretical model to the accuracy achieved by five single-equation models, one for each endogenous variable. The form of the single-equation models is

$$dy/dt = a + by$$

Where y is a scalar representing one of the expectation variables or academic performance, and a and b are scalar constants. Table 5 presents R-squares that compare the accuracy of the full model to the accuracy of these two naive models. To be explicit, the R-squares in table 5 are defined by:

$$R^2 = 1 - \frac{MSE(M)}{MSE(N)}$$

where MSE(M) denotes the mean-squared error when forecasted values are derived from the full model, and MSE(N) denotes the mean-square error derived from one of the "naive" models (no change or single-equation model).

TABLE 5

FORECASTING R-SQUARES COMPARING THE THEORETICAL MODEL TO TWO "NAIVE" MODELS

Endogenous Variables	Naive Model: No Change								Naive Model: Single-Differential Equation							
	W1 ⟶ W3				W2 ⟶ W3				W1 ⟶ W3				W2 ⟶ W3			
	FB	FW	MB	MW	FB	FW	MB	MW	FB	FW	MB	MW	FB	FW	MB	MW
AP	.231	.246	.346	.186	-.076	-.295	.101	.099	.072	.097	.230	.152	.047	.019	.195	.146
EEP	.243	.138	.065	.135	.108	-.006	-.008	.083	.198	.075	.043	.066	.037	-.084	-.052	.043
OEP	.069	.129	.050	.118	.125	.035	.018	-.053	.090	.078	.003	.127	.108	.051	-.090	.036
EE	.161	.264	.273	.234	.017	.238	.263	.173	.076	.251	.209	.164	.010	.228	.174	.063
OE	.098	.100	.199	.178	.022	.056	.170	-.007	.038	.092	.138	.064	.049	.013	.091	-.031

NOTES:

1. W2 ⟶ W3 indicates wave-two forecasts of wave three, and W1 ⟶ W3 indicates wave-one forecasts of wave three.

2. The column titles are defined as follows: FB = female blacks, FW = female whites, MB = male blacks, and MW = male whites.

3. The abbreviations for the variables are: AP = academic performance, EEP = educational expectation of parents, OEP = occupational expectation of parents, EE = educational expectation (of youth), OE = occupational expectation (of youth).

The data in table 5 are mildly encouraging in that the vast majority of the R-squares are positive, indicating that the full theoretical model gives more accurate forecasts than either of the "naive" models. The negative values mean that the "naive" model predicts better than the full model, and the absolute magnitude of the negative coefficients tells how much better the "naive" model does. The coefficients in table 5 exhibit a dramatic decline in value over those in table 4, however. Most are, in fact, quite small in magnitude. The conclusion is inescapable. Most of the high R-squares in table 4 are due to the stability over time of each of the five endogenous variables. It is clear that the theory needs refinement before it can offer useful forecasts of senior-year career expectations based on inputs from earlier years. Nevertheless, it is important to note that the present model is one of the first attempts to formulate the dynamics of career development into mathematics. The uniformities displayed in the data offer hope that careful respecification of the model could substantially improve the forecasts. Some expansions are tested in the remainder of this chapter, and detailed respecifications are proposed in chapter 5.

Theoretical Features of the Basic Model

This section discusses the patterns of effects contained in the estimates of the differential equations. The instantaneous effects or "fundamental parameters" of the differential-equation model are examined first, along with auxiliary data such as cross-lagged (OLS) regression coefficients, and eigenvalues of the system. The long-term effects of the exogenous variables are discussed next. The reader is reminded that all exogenous variables are standardized to zero mean and unit variance using sample estimates of means and standard deviations. All endogenous variables are standardized using time-one sample estimates of population means and standard deviations. The data are not standardized using separate means and standard deviations for each time point because to do so would remove time changes in averages and variability from the data. Justification of this procedure is reviewed in chapter 3 and laid out in detail in Hotchkiss (1979a).

Table 6 displays the sample estimates of the coefficients of the differential equations ($\underline{A}$ and $\underline{B}$), the corresponding regression coefficients ($\underline{A}$* and $\underline{B}$*), regression multiple R-squares and corresponding bivariate r-squares for each equation, and the eigenvalues of $\underline{B}$. Readers unfamiliar with differential-equation systems might take exception to the fact that all diagonal entries in the matrix $\underline{B}$ are negative and relatively large in absolute magnitude. This is a normal pattern, however; substantively, it indicates that, ceteris paribus, extremely high or extremely low levels of each endogenous variable generate rapid change back toward intermediate levels.

The multiple R-squares in the table are extremely high, but these are regression R-squares and not forecasting R-squares; hence, in that the time-one measurement of each endogenous variable is one regressor in the equation for the corresponding time-two measure, high correlations are to be expected. The high multiple R-squares are not due entirely to high correlation of the variables with themselves over time, however, as shown by comparing the multiple R-squares to the bivariate r-squares in which time-one and time-two measures are the variables being correlated.

In view of the continuing concern for equality of opportunity in the United States, perhaps the most compelling observation in the table is that SEB exercises very little immediate impact on the rate of change in any of the endogenous variables. Furthermore, the accumulated total effects over the seven to eight months between measurements one and two also are negligible, as shown by observing the cross-lagged regression coefficients under the column labeled SEB. In so far as expectations translate into attainment, then, the small magnitude of these coefficients appear to support those who de-emphasize the impact of family background on attainment (e.g., Featherman and Hauser 1978; Rehberg and Rosenthal 1978). On the other hand, the effects of mental ability also are uniformly small, thus appearing to contradict the view that merit dominates class background in determining achievement. As will be seen in a moment, however, the

TABLE 6

COEFFICIENTS OF THE DIFFERENTIAL EQUATIONS, REGRESSION COEFFICIENTS, EIGENVALUES, AND R-SQUARES

Female Blacks

Coefficients of the Differential Equations

Dependent	A		B						Eigenvalues	
Variable	Intercept	SEB	MA	AP	EEP	OEP	EE	OE	Real Part	Imaginary Part
dAP/dt	-.214	-.037	.205	-.754	-.311	.488	.474	-.270	-1.461	0
dEEP/dt	.113	-.051	.237	-.020	-.867	.666	.477	-.201	-.201	0
dOEP/dt	-.042	-.057	.005	.006	.279	-.554	-.073	.157	-.729	0
dEE/dt	.144	.011	.023	.137	.087	-.259	-.558	.424	-.451	.104
dOE/dt	.118	.064	-.053	-.032	-.061	.239	.097	-.561	-.451	-.104

Regression Coefficients

Dependent	A*		B*						Regression	Bivariate
Variable	Intercept	SEB	MA	AP	EEP	OEP	EE	OE	R-Square	r-Square
AP	-.176	-.038	.153	.412	-.098	.172	.214	-.053	.451	.372
EEP	.103	-.057	.198	.012	.404	.318	.244	-.009	.665	.563
OEP	-.020	-.056	.030	-.001	.150	.580	.003	.080	.535	.503
EE	.150	.026	.027	.073	.077	-.098	.547	.246	.478	.450
OE	.110	.054	-.053	-.014	-.006	.133	.046	.527	.505	.477

Female Whites

Coefficients of the Differential Equations

Dependent	A		B						Eigenvalues	
Variable	Intercept	SEB	MA	AP	EEP	OEP	EE	OE	Real Part	Imaginary Part
dAP/dt	-.335	.051	.132	-.594	-.398	.370	.174	.168	-.085	0
dEEP/dt	-.082	.097	-.137	.177	-.825	.552	.432	-.131	-.601	.178
dOEP/dt	-.096	-.006	-.028	.066	.191	-.346	-.011	.060	-.601	-.178
dEE/dt	.048	.070	.128	.044	.245	-.080	-.413	.112	-1.061	0
dOE/dt	.097	.089	.039	-.042	.088	.251	-.017	-.502	-.354	0

Regression Coefficients

Dependent	A*		B*						Regression	Bivariate
Variable	Intercept	SEB	MA	AP	EEP	OEP	EE	OE	R-Square	r-Square
AP	-.284	.042	.143	.462	-.165	.201	.057	.134	.586	.510
EEP	-.117	.092	-.008	.117	.403	.354	.272	-.030	.792	.680
OEP	-.118	.008	-.008	.059	.113	.711	.292	.043	.734	.713
EE	.035	.087	.004	.044	.141	.012	.641	.073	.696	.664
OE	.076	.085	.045	-.012	.072	.205	.004	.533	.629	.554

TABLE 6, continued

Male Blacks

Coefficients of the Differential Equations

Dependent		A				B			Eigenvalues	
Variable	Intercept	SEB	MA	AP	EEP	OEP	EE	OE	Real Part	Imaginary Part
dAP/dt	-.367	.072	.243	-.666	-.216	.161	.255	-.017	-.136	0
dEEP/dt	-.099	-.080	-.177	.085	-.433	.136	.176	.121	-1.038	0
dOEP/dt	-.176	-.010	-.067	.026	.325	-.509	-.114	.211	-.624	.200
dEE/dt	.261	.010	.035	.277	.192	.168	-.752	.128	-.624	-.200
dOE/dt	.146	.077	.118	.145	-.082	-.061	.365	-.566	-.503	0

Regression Coefficients

Dependent		A*				B*			Regression	Bivariate
Variable	Intercept	SEB	MA	AP	EEP	OEP	EE	OE	R-Square	r-Square
AP	-.293	.069	.223	.452	-.100	.102	.116	.005	.510	.420
EEP	-.096	-.068	-.152	.084	.604	.113	.131	.104	.651	.612
OEP	-.178	-.012	-.074	.034	.211	.541	-.011	.148	.628	.583
EE	.155	.152	.047	.163	.116	.123	.438	.095	.555	.483
OE	.153	.080	.141	.118	-.047	-.009	.215	.503	.650	.592

Male Whites

Coefficients of the Differential Equations

Dependent		A				B			Eigenvalues	
Variable	Intercept	SEB	MA	AP	EEP	OEP	EE	OE	Real Part	Imaginary Part
dAP/dt	-.326	-.073	.070	-.493	-.126	.123	.144	.028	-.112	0
dEEP/dt	-.026	.072	-.053	.146	-.480	.324	.034	-.051	-1.055	0
dOEP/dt	-.040	.027	.081	.043	.357	-.506	-.179	.184	-.684	0
dEE/dt	.044	.137	.034	.139	.283	.087	-.821	.240	-.487	.022
dOE/dt	-.026	.091	-.056	.135	-.009	.330	.051	-.526	-.487	-.022

Regression Coefficients

Dependent		A*				B*			Regression	Bivariate
Variable	Intercept	SEB	MA	AP	EEP	OEP	EE	OE	R-Square	r-Square
AP	-.307	-.059	.074	.546	-.054	.081	.072	.042	.558	.533
EEP	-.007	.068	-.030	.108	.593	.230	.006	-.006	.776	.747
OEP	.050	.034	.063	.052	.229	.598	-.092	.104	.791	.765
EE	.006	.124	.025	.108	.172	.121	.364	.138	.766	.667
OE	-.054	.087	-.033	.101	.041	.234	.014	.548	.788	.733

NOTE: The abbreviations for the variables are: SEB = socioeocnomic background, MA = measured mental ability, AP = academic performance, EEP = educational expectation of parents, OEP = occupational expectation of parents, EE = educational expectation (of youth), OE = occupational expectation (of youth).

accumulated total effects over the long run reveal a different pattern. To anticipate briefly, for whites of both sexes, the long-run effects of SEB on the expectation variables exceed the effects of mental ability and mental ability exercises a somewhat greater effect on AP than does SEB. This pattern is not observed among blacks, however.

There are several noteworthy patterns among the coefficients of the endogenous variables ($\underline{B}$). First, observe the data for male whites in the last panel of table 6. Parental occupational expectation (OEP) exercises the dominant influence on rate of change in youth's occupational expectation (OE) ($b_{53} = .330$) but the reciprocal effect of the youth's own occupational expectation on the parents' occupational expectation of the youth also is fairly large ($b_{35} = .184$). This produces an interesting feedback loop:

$$\begin{tikzcd} \text{OEP} \arrow[r, shift left, ".330"] & \text{OE} \arrow[l, shift left, ".184"] \end{tikzcd}$$

This pattern is not repeated for educational expectation. The educational expectation of parents (EEP) exercises a fairly strong effect on the rate of change in youth's educational expectation (EE), but the reverse effect is nearly absent. The accumulated total effect of EEP on EE between time-one and time-two is more modest than its effect on the rate of change in EE, however (compare b_{42} to b^*_{42}).

Among male whites, parental educational and occupational expectations of their child exercise substantial reciprocal effects on each other ($b_{32} = .357$, and $b_{23} = .324$). In contrast, the effect of the youth's occupational expectation on the youth's educational expectation is considerably larger than the reverse effect ($b_{45} = .240$, and $b_{54} = .051$). A similar observation applies to the accumulated total effects between time-one and time-two.

Another interesting feedback in the data for male whites is between educational expectation of youth and their academic performance. Generally, it is assumed in empirical investigation that academic performance influences educational expectation and the reverse effect is absent (see Sewell and Hauser [1975], for example), but sometimes it is assumed that educational expectation (EE) affects academic performance (AP) but AP does not affect EE (Porter 1974). For male whites, the effect from EE to AP is about the same magnitude as the effect from AP to EE. In the remaining race and sex combinations, EE affects change in AP at least as strongly as AP affects change in EE. Thus, there is some reason to doubt the general assumption that academic performance affects educational expectation but the reverse effect is absent. Of course, the present measure of AP is a self-report measure. Further exploration of this feedback using grades from school records certainly is warranted.

There are two negative coefficients among the change coefficients (B) for male whites which, if not statistical artifacts, require some explanation. Status attainment theory would not predict any off-diagonal entries to be negative. The apparent negative impact of parental educational expectations (EEP) on the youth's academic performance (AP) is large enough in magnitude that it cannot be dismissed (-.126). The same comment applies to the negative impact of EE on OEP (-.179). Since estimates of the parameters of the differential equations may be subject to high sampling error, confidence in these negative effects depends on whether they are repeated in the remaining sex-race subgroups. Inspection of the corresponding coefficients for females and blacks reveals that in every case these negative effects do occur,[25] but they tend to be smaller in magnitude for the effect of EE on OEP than for the effect of EEP on AP. In the latter case, the negative coefficients not only persist across all subgroups, but exhibit higher magnitudes among females and blacks than for male whites. Further, the negative sign associated with the effect of EEP on change in AP persists across measurement methods, but the negative effect of EE on OEP does not.[26]

Because of the persistence of the negative effect of parental educational expectation on youth's academic performance, some interpretation is merited. Hotchkiss (1980; 1981) recently has proposed a general definition of status-discrepancy effect. The definition encompasses a special case that applies to the present observation. The simplest form of a discrepancy effect arises when the signs of two regression coefficients in an equation are opposite each other. If the coefficients add up to zero, a straightforward interpretation is in order: the difference between two status variables produces an effect on the dependent variable. If the coefficients do not add to zero, then a weighted difference produces the effect. Extension of this idea to cover coefficients of a differential equation is obvious. In the particular case at hand, the interpretation is that when parental educational expectation of youth is not consistent with the parents' occupational expectation and the youth's educational and occupational expectations, the youth's academic performance is affected; the more OEP, EE, and OE exceed EEP, the higher the change in AP. The hypothesis is one of a linear impact of the discrepancy between EEP and the other expectation variables. This interpretation does not encounter any special difficulties related to identification as so often claimed in methodological critiques of status-discrepancy theory (e.g., Blalock 1966). Full defense of this viewpoint is given in the papers by Hotchkiss cited above. The reason why discrepancy between EEP, OEP, EE and OE should affect AP is not clear. Because of the lack of obvious rationale for the interpretation, confidence that the negative effect of EEP on AP is not an artifact must await further investigation.

---

[25] Negative coefficients for other variable pairs are scattered throughout tables 3, 4, 5, and 6, but they tend to be small in magnitude and the negative signs are not repeated across all four subgroups.

[26] To conserve space, tables indicating these results are not published in this report.

One of the outstanding advantages of the differential-equation model is that forecasting to any point along a continuous time scale is built into the theoretical model. Thus, one is permitted to compare the short-run effects of the exogenous variables (SEB, MA) to their long-run effects. This comparison is, indeed, instructive. Table 7 shows the long-run (equilibrium) effects of SEB and MA on each of the endogenous variables. The negligible effects of SEB and MA in the short run already have been observed. In contrast, for whites, the long-run effects of SEB on all four career-expectation variables (EEP, OEP, EE, and OE) are pronounced. In each of these four cases, standardized coefficients exceed .25 among male whites, the impact on the youth's own occupational-expectation level being the largest (.401). In contrast, mental ability exercises relatively small long-run effects on endogenous variables. The dominance of SEB over MA is even more pronounced among female whites than among male whites.

In contrast to the observations for whites, the effects of socioeconomic background among blacks does not dominate that of mental ability. In some cases neither SEB nor MA have large effects, in some cases they both exercise modest effects, and in some cases MA has a stronger impact than SEB. The latter comment is particularly true for educational and occupational expectations of male blacks. In part, these results may be due to a truncated status distribution among black respondents, but the pattern varies somewhat erratically across equations and between sexes. Consequently, it is best to avoid overinterpretation of these coefficients. Table 7 also displays the long-run indirect and direct effects. The indirect effect of x on y over a given time interval is the change in y produced by a change in x that traces through at least one endogenous variable other than y (see chapter 2). Among whites, the indirect effects of SEB on the four career-expectation variables are substantial; in each case they exceed one-half the magnitude of the total effect. If one imagines that the projected long-run expectations of youth ultimately are realized (or approximated), then the data here lend support to the view expressed in the Wisconsin model, viz, that socioeconomic background is translated into career attainments in part through a socialization process whereby significant others mold the career goals of youth (Sewell, Haller, and Portes 1969; Haller and Portes 1973). This description does not apply so well to blacks, however. The main reason is that the total effects of SEB are smaller among blacks than among whites.

The indirect effects of mental ability are uneven; in some cases they are large enough to require a negative direct effect in order to sum to the

TABLE 7

EQUILIBRIUM TOTAL EFFECTS, DIRECT EFFECTS, AND INDIRECT EFFECTS

Female Blacks

	Total Effects			Direct Effects			Indirect Effects		
D.V.	Intercept	SEB	MA	Intercept	SEB	MA	Intercept	SEB	MA
AP	-.188	-.051	.265	-.284	-.050	.272	.097	-.001	-.007
EEP	.440	-.133	.473	.130	-.059	.274	.310	-.074	.199
OEP	.176	-.163	.229	-.076	-.103	.008	.253	-.061	.221
EE	.446	.127	.029	.258	.021	.041	.188	.106	-.012
OE	.325	.084	-.058	.210	.114	-.094	.115	-.030	.036

Female Whites

	Total Effects			Direct Effects			Indirect Effects		
D.V.	Intercept	SEB	MA	Intercept	SEB	MA	Intercept	SEB	MA
AP	-.805	.251	.327	-.563	.086	.223	-.242	.165	.104
EEP	-1.426	.858	-.065	-.100	.117	-.166	-1.327	.741	.102
OEP	-1.298	.577	.033	-.277	-.018	-.008	-1.021	.595	.041
EE	-.732	.747	.047	.116	.169	.031	-.848	.579	.016
OE	-.613	.569	.094	.194	.176	.118	-.807	.393	-.024

Male Blacks

	Total Effects			Direct Effects			Indirect Effects		
D.V.	Intercept	SEB	MA	Intercept	SEB	MA	Intercept	SEB	MA
AP	-.572	.169	.489	-.551	.107	.365	-.021	.061	.124
EEP	-.518	-.006	-.023	-.229	-.184	-.409	-.290	.178	.386
OEP	-.606	.060	.031	-.346	-.020	-.132	-.260	.082	.162
EE	-.099	.132	.320	.348	.014	.047	-.447	.118	.273
OE	.189	.258	.540	.259	.135	.208	-.070	.123	.332

Male Whites

	Total Effects			Direct Effects			Indirect Effects		
D.V.	Intercept	SEB	MA	Intercept	SEB	MA	Intercept	SEB	MA
AP	-.876	-.024	.234	-.662	-.147	.142	-.214	.123	.092
EEP	-.608	.306	.131	.054	.149	-.110	-.662	.157	.241
OEP	-.639	.258	.251	-.079	.054	.160	-.560	.204	.091
EE	-.583	.401	.190	.053	.167	.042	-.636	.234	.148
OE	-.721	.362	.127	-.048	.172	-.107	-.672	.189	.234

NOTE: Abbreviations for the variables are: SEB = socioeconomic background, MA = mental ability, AP = academic performance, EEP = educational expectation of parents, OEP = occupational expectation of parents, EE = educational expectation (of youth), OE = occupational expectation (of youth).

small total effect. These results are counterintuitive and require verification before they are taken seriously.[27]

The eigenvalues displayed in table 6 reveal important information about the behavior of the system of career-expectation variables over time. The important observation in the present context is the fact that the real part of each eigenvalue is negative. These negative values imply that the long-run total effect of the endogenous variables on each other approaches zero.[28] Thus, the ultimate career expectations of youth are determined by the exogenous variables irrespective of where those expectations stand during the sophomore year in high school.

Again, it is useful to imagine that the long-run expectations of youth are approximated by adult attainments. In this circumstance, since mental ability has little impact on long-run career expectations of white youth, the implication is that ultimate achievements are determined by socioeconomic background, operating indirectly through a socialization process. Figure 5 illustrates the operation of SEB over time. The graph shows the theoretical course for each of the five endogenous variables for a hypothetical male white youth over a two-year time interval. This hypothetical youth comes from a family with a composit status index one standard deviation below the mean; he is 1.3 standard deviations above average in mental ability. As shown by the graph, this youth has high expectations as a sophomore, and his parents have high expectations for him. His perception of academic performance is also high. Over the two-year interval shown on the graph, all these variables decline to just about the average, or just a little above. If left to operate indefinitely, all five variables would decline to about one-half to one full standard deviation below their respective time-one means.

Of course, given the lack of attainment data for this report and the tentative nature of the differential-equation model of career expectations, these comments necessarily are speculative. At the very least, however, they do illustrate the powerful capability gained by explicit expression of theory by a dynamic model.

---

27. In the previous report on this study, results were reported using subjective-probability measures exclusively. The indirect effects of mental ability under these conditions tend to be low, as are the total effects, except in the case of EE and OE of male blacks. The strong effect of SEB among whites generally also is apparent with exclusive use of subjective probabilities (Hotchkiss and Chiteji 1980: 56-57).

28. This is a standard result of the mathematics of differential equations (see Hotchkiss 1979a; Doreian and Hummon 1976).

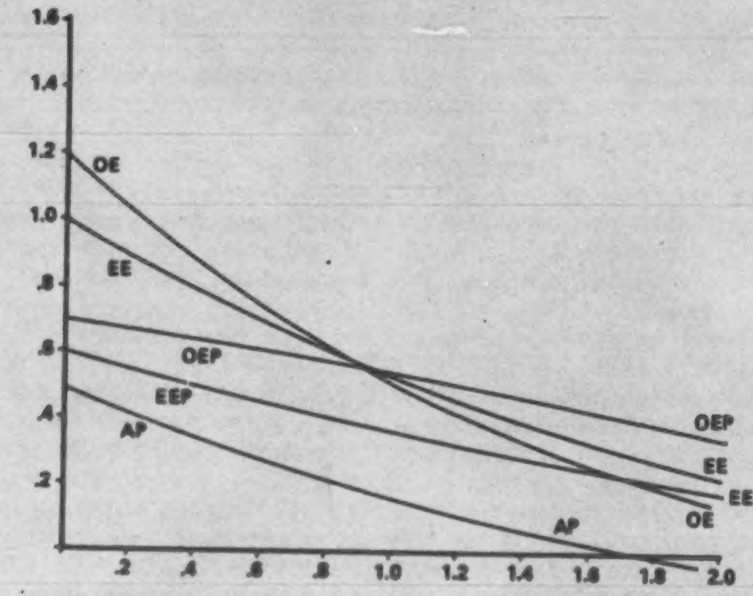


Figure 5. Time paths of endogenous variables for male whites.

NOTES

1. Variable abbreviations are: SEB = socioeconomic background, MA = mental ability, AP = academic performance, EEP = educational expectation of parents, OEP = occupational expectation of parents, EE = educational expectation (of youth), OE = occupational expectation (of youth).
2. Initial values for SEB, MA, AP, EEP, OEP, EE, OE in that order are: 1.0, 1.3, .5, .6, .7, 1.0, 1.2

It is of interest to compare the estimates of total effect derived from the differential-equation model to those obtained by the standard regression method. The usual method of estimating total effects of the exogenous variables is to regress each endogenous variable against the exogenous variables without controlling for any endogenous variables (Alwin and Hauser 1975). As an illustration, regression and differential-equation estimates for the sample of male whites are shown in table 8. The regression statistics indicate a much more important role for mental ability than do estimates of long-run effects generated from the differential equations. The regression estimates of effects of SEB are somewhat smaller than the corresponding differential-equation estimates. The most straightforward explanation of these results is that the regression calculations were applied to a system which had not reached equilibrium, for it can be shown mathematically that the regression method yields the long-run effects of the differential equation model if the system has reached equilibrium (see Hotchkiss and Chiteji [1979: chapter 4], and chapter 2 of this volume).

The point here is not to demonstrate a "flaw" in the regression estimates of total effects. The differential-equation model has received insufficient empirical support to permit such a demonstration. Rather, the conflicting results of the two sets of estimates show that much research remains before the relative impact of SEB and MA on career development can be determined confidently. Certainly, such determination requires a dynamic theoretical model of the process of job mobility. Few such models are available, and none has been subjected to thorough empirical test.[29]

TABLE 8

COMPARISON OF LONG-RUN TOTAL EFFECTS OF SEB AND MA
AS ESTIMATED BY THE DIFFERENTIAL EQUATIONS TO REDUCED-FORM REGRESSION
ESTIMATES OF TOTAL EFFECTS: WHITE MALES

Endogenous Variable	Differential-equation Estimates			Regression Estimates		
	Intercept	SEB	MA	Intercept	SEB	MA
AP	-.876	-.024	.234	-.468	.018	.408
EEP	-.608	.306	.131	-.169	.320	.369
OEP	-.639	.258	.251	-.270	.248	.511
EE	-.583	.401	.190	-.166	.379	.409
OE	-.721	.362	.127	-.321	.308	.458

NOTE: Abbreviations for the variables are: SEB = socioeconomic background, MA = mental ability, AP = academic performance, EEP = educational expectation of parents, OEP = occupational expectation of parents, EE = educational expectation of the youth, OE = occupational expectation of the youth.

Although the specific patterns of effect parameters differ among race-sex subsamples, there are important similarities among the four groups. First, since the real part of all eigenvalues in each subsample is negative, a stable long-run equilibrium exists in each group. Secondly, the numerical estimates reveal little evidence of oscillation. This is because the eigenvalues are either real, or the magnitude of the imaginary parts of complex eigenvalues is such that oscillation is negligible. Table 6 also reveals fairly high R-squares for all race-sex subsamples, the lowest being for female blacks. As with white males, a substantial part of the multiple R-squares can be attributed to the bivariate correlation for each endogenous

---

29. Sorensen (1979) offers a differential-equation model of intragenerational job changes and reports empirical tests from the census public-use sample. Sorensen's model has not been submitted to the intense empirical scrutiny that the status-attainment model has received, however.

variable between time-one and time-two measures. But, in no case can all the multiple R-squares be attributed to this source.

The estimates of the instantaneous effect coefficients (B̲) among the endogenous variables show substantial variation across subgroups, but there are certain rough regularities. First, effects of parental expectations of their children tend to be fairly strong across subgroups, but whites of both sexes conform to theoretical prediction more closely than do blacks, viz, that EEP strongly affects EE and OEP strongly affects OE (see Haller, forthcoming). Also, there tends to be strong feedback effects among parental educational and occupational expectations in all groups, and these feedbacks tend to be stronger than the feedbacks between the youths' own educational and occupational expections.

In all subgroups except male whites, the effect of the youths' own educational expectation (EE) on parental educational expectation (EEP) is high and equals or exceeds the impact of EEP on EE; this observation is especially pronounced among females of both races. Among black males, the youth's occupational expectation for self (OE) more strongly affects the occupational expectation his parents hold for him (OEP) than the reverse. Observations such as these raise important questions about the role of parental significant others for minorities and females. It is possible that the strong effects of parents on their children observed in cross-sectional analyses in past research are artifacts of high cross-sectional correlations generated by reverse-direction effects--children influencing parents. The interpersonal dynamics of these "reverse-direction" effects are not difficult to imagine. The youth develop expectations about their future education and jobs from a variety of sources, including teachers, course content in school, peers, media, and parents. The youth's expectations developed from these myriad sources are communicated to the parents who then report them on questionnaire surveys. Why the reverse-direction effects should predominate in groups other than male whites is more difficult to explain. Perhaps parents are more insistent about their aspirations for male white youngsters than for other youth. Of course, this explanation is highly speculative.

It is important to conclude this discussion of the feedback from children's expectations to parental expectations by emphasizing the tentative nature of the findings. The measurement methods remain crude, although they are good by contemporary standards. Further, variability of estimates of differential-equation parameters may account for some of the anomalous feedbacks. Finally, as will be considered at length in the following chapter, specification of the dynamics of career development into a mathematical model is in its infancy. There is ample room for expansion of the model to account for important processes suggested by theory in different academic disciplines.

In spite of some rough tendencies to uniformities of effects of endogenous variables on each other (B̲), the main impression is one of variability across race and sex. Numerous empirical studies report comparisons between race and/or sex groups (Featherman and Hauser 1976;

McClendon 1976; Tyree and Treas 1974; Suter and Miller 1973; Curry et al. 1976, 1978, Treiman and Terrell 1975; Hout and Morgan 1975; Portes and Wilson 1976; Porter 1974). A bewildering array of statistical interactions have been reported in these studies, whether they apply to attainment or expectation. Treiman and Terrell offer a succinct summary: "... as usual, everything interacts with race." (Treiman and Terrell 1975: 198). To a somewhat lesser extent this comment also applies to sex. The results here are no exception. Everything interacts with race, and with sex.

Curry and associates (1978) tested several theoretically-based hypotheses concerning sex differences in development of educational and occupational expectations. Several hypotheses involved presumed influence of the females' attitude toward homemaking and motherhood, but few were supported by the data. Porter (1974) interprets his data on race differences as supporting racial differences on Turner's dimension of "contest" vs. "sponsored" mobility. In spite of isolated theoretical ties to data such as these, nothing approaching an adequate theory of race-sex differences in developing career expectations exists. The importance of such a development is clear, however. Important advantages could be expected from an adequate theoretical model accounting for race and sex differences. First, the parsimony achieved by such an integrated theory would be impressive. No longer would it be necessary to duplicate all numerical calculations within each race-sex subgroup. Secondly, a substantial gain in statistical efficiency could be expected if calculations were conducted on total samples rather than race-sex subsamples. Finally, the substantive contribution to understanding race-sex differences in career expectations and attainments would be the most important contribution of an integrated model.

Effects of Peers and Income Expectations

Peer influence on occupational and educational expectations of youth has played a prominent role in development of the Wisconsin model (Sewell and Hauser 1975; Alexander and Eckland 1975; Curry et al. 1976, 1978). Although income expectations have not entered into path models of the social psychological process of developing career expectations, their inclusion has been viewed as an important next step (Sewell and Hauser 1975; Haller, forthcoming). This section reports the results of incorporating peer and income expectation variables into the differential equations as linear components.

Five measures of peers' attitudes and behavior were tried. These are:

- Peers' Educational Expectation of Ego (PEEE): Students were asked to guess the level of education that their peers expected them to achieve.
- Peers' Educational Expectation for Peer (PEEP): Students were asked to estimate the level of education they thought most of their peers would achieve.

- Peers' College Plans (PCP): Students were asked to estimate the percentage of their peers they thought would go to college.

- Peers' Occupational Expectation for Ego (POEE): Students were asked to name a job they thought their peers would not be surprised to see them have.

- Peers' Occupational Expectation for Peer (POEP): Students were asked to name a job they thought their peers might be likely to achieve.

Two of these peer variables (PEEE and POEE) are intended to assess the influence of peers as "definers," and the remaining three (PEEP, PCP, and POEP) reflect peers' "modeling" influence. These variables were appended to the basic model as linear endogenous components; they were added in pairs, as follows: (PEEE, POEE), (PEEP, POEP), (PCP, POEP). Table 9 reports forecasting R-squares by race, sex, and time interval for each of these three pair additions. R-squares for white females with the (PCP, POEP) pair are omitted from the table, however, because the real part of one eigenvalue of $\underline{B}^*$ was negative, rendering the remaining calculations of little value.

Two features stand out from the analyses with peer variables. First, no matter which pair of peer variables is appended to the basic model, forecast accuracy of the peer variables is dismally low, with R-squares sometimes turning negative. Secondly, none of the pairs of peer variables add more than a trivial amount to the forecast accuracy of the other endogenous variables; frequently, in fact, inclusion of the peer variables causes forecast accuracy of the remaining variables to decline. At least for the present, then, in the interest of parsimony it appears advisable to drop the peer variables from the model. Because of the theoretical appeal of the idea of peer influence, however, additional work with peer attitudes is merited. Experimenting with alternative measurements is probably the most promising approach. Direct measurements of expectations for all students in a school would allow better assessment of the influence of peer modeling (Haller and Butterworth 1960; Hout and Morgan 1975).

Four income-expectation variables also were introduced into the model. These income variables are:

- IEP(SP): Income expectation of parents for the youth as measured by subjective probabilities.

- IEP(CL): Income expectation of parents for the youth as measured by the checklist method.

- IE(SP): Income expectation of youth for self as measured by subjective probabilities.

- IE(CL): Income expectation of youth for self as measured by the checklist method.

TABLE 9

FORECASTING R-SQUARES TO ASSESS PEER INFLUENCE ON CAREER EXPECTATIONS

Wave 1 Forecasts Wave 3

Endogenous Variable	Female Blacks			Female Whites			Male Blacks			Male Whites		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
AP	.169	.158	.170	.328	.313		.301	.261	.262	.384	.372	.389
EEP	.545	.544	.552	.570	.561		.474	.474	.469	.646	.638	.630
OEP	.479	.460	.461	.603	.598		.430	.454	.455	.707	.680	.689
EE	.405	.346	.341	.627	.626		.498	.484	.486	.628	.624	.620
OE	.351	.324	.319	.478	.468		.491	.460	.462	.615	.600	.609
PEEE	.205			.459			.384			.561		
POEE	-.002			.127			.034			.297		
PEEP		.073			.179			.200			.428	
POEP		.008			.142			-.138			.240	
PCP			-.021						.125			.392
POEP			.016						-.162			.217

Wave 2 Forecasts Wave 3

Endogenous Variable	Female Blacks			Female Whites			Male Blacks			Male Whites		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
AP	.234	.256	.260	.402	.389		.330	.311	.305	.446	.449	.457
EEP	.571	.561	.565	.620	.609		.575	.580	.566	.731	.744	.750
OEP	.555	.536	.536	.654	.652		.506	.507	.516	.774	.766	.777
EE	.446	.481	.483	.639	.615		.576	.568	.574	.646	.650	.645
OE	.452	.442	.442	.537	.523		.489	.495	.500	.708	.710	.709
PEEE	.290			.525			.400			.579		
POEE	.035			.156			.030			.311		
PEEP		.129			.316			.214			.519	
POEP		.015			.138			-.153			.279	
PCP			.043						.195			.464
POEP			.013						-.218			.247

NOTES:

1. Abbreviations for the variables are: AP = academic performance, EEP = educational expectation of parents, OEP = occupational expectation of parents, EE = educational expectation (of youth), OE = occupational expectation (of youth), PEEE = peer educational expectation of ego, POEE = peer occupational expectation of ego, PEEP = peer educational expectation of peer, POEP = peer occupational expectation of peer, PCP = peers' college plans.

2. Blank entries in each column correspond to variables not included in the model, except that Model 3 for female whites is omitted entirely, as explained in the text.

Both IEP variables are intended as "definer" variables. As with thepeer variables, the income variables were appended to the basic model in pairs, as follows: [IEP(SP), IE(SP)], [IEP(CL), IE(CL)].

Forecast accuracies generated by inclusion of the income variables are reported in table 10. The results parallel closely those observed with the peer variables. The accuracy with which the model forecasts the income variables is low, and inclusion of the income variables contributes nothing to the accuracy of forecasts for the other endogenous variables in the model. Again, in the interest of parsimony, it is advisable to omit the income variables from the model. Future work with income expectations probably should concentrate on measurement. All bivariate correlations involving income expectations in the present data set are low, thus suggesting poor measurement procedures. Efforts to improve measurement of income expectation probably should include indirect methods that depend on lists of consumer goods. Respondents could be asked whether they expected to own at age thirty-five, say, each item in a list of goods. The subjectiveprobability method could be applied, yes-no alternatives might work, or the Galileo method of assessing "distance" between the self and each item might prove useful (see Woelfel and Fink 1980).

Adjusting the Time Scale

The process of generating the forecasts entails calculation of a predicted matrix of cross-lagged regression coefficients. One of the appealing aspects of the differential-equation model is that it incorporates formulas for adjusting these cross-lagged regression matrices to account for variation in the length of the time interval between measurements. With three waves of data it is possible to compare forecasted matrices of cross-lagged regression coefficients to the observed matricies. When these comparisons are made it is found that the diagonal entries of the forecasted matrices of $\underline{B}^*$ coefficients are smaller than the corresponding entries in the observed matrices. These observations agree with the hypothesis proposed in the previous report on this study (Hotchkiss and Chiteji 1980). Since the diagonal entries in forecasted matrices of $\underline{B}^*$ coefficients decline with increasing time, this discrepancy between the observed and predicted matrices suggests that adjustment of the time scale might improve the forecasts.

To find out whether adjustment of the time scale does improve the accuracy of forecasts, the length of the time interval over the forecasting period was adjusted to maximize the R-squares, in a manner analogous to

TABLE 10

FORECASTING R-SQUARES FOR TWO MODELS INCLUDING INCOME EXPECTATIONS

Wave 1 Forecasts Wave 3

Exogenous Variable	Female Blacks		Female Whites		Male Blacks		Male Whites	
	SP	CL	SP	CL	SP	CL	SP	CL
AP	.163	.177	.309	.322	.256	.276	.373	.384
EEP	.563	.556	.557	.569	.471	.473	.630	.630
OEP	.494	.479	.603	.606	.456	.445	.683	.689
EE	.310	.345	.599	.615	.488	.484	.625	.623
OE	.328	.317	.432	.473	.448	.460	.599	.608
IEP(SP)	.185		.017		-.051		.172	
IE(SP)	.118		.212		.199		.104	
IEP(CL)		.069		.139		-.165		.147
IE(CL)		.139		.023		.205		.148

Wave 1 Forecasts Wave 3

Exogenous Variable	Female Blacks		Female Whites		Male Blacks		Male Whites	
	SP	CL	SP	CL	SP	CL	SP	CL
AP	.272	.270	.386	.395	.303	.318	.439	.431
EEP	.572	.576	.604	.613	.584	.585	.749	.750
OEP	.541	.557	.660	.662	.534	.539	.773	.778
EE	.437	.458	.625	.629	.574	.577	.654	.649
OE	.413	.441	.497	.539	.492	.508	.700	.707
IEP(SP)	.337		.007		-.021		.259	
IE(SP)	.152		.294		.231		.170	
IEP(CL)		.114		.180		-.158		.227
IE(CL)		.175		.085		.238		.193

NOTES:

1. Abbreviations of variables are: AP = academic performance, EEP = educational expectation of parents, OEP = occupational expectation of parents, EE = educational expectation (of youth), OE = occupational expectation (of youth), IEP(SP) = income expectation of parents based on subjective probability, IE(SP) = income expectation (of youth) based on subjective probability, IEP(CL) = income expectation of parents based on checklist, IE(CL) = income expectation (of youth) based on checklist.
2. The column headings are: SP = subjective probability, CL = checklist.
3. Blank entries indicate variables omitted from the model.

calculation of least-squares regression coefficients.[30] Results of these calculations reveal promising improvement in the R-squares. Table 11 contains R-squares resulting from the adjusted time scale and the original forecasting R-squares for comparison. These data show that adjusting the time scale does, indeed, improve the R-squares, on the average of nearly five points when $\Delta t = 2.00$, and almost six points when $\Delta t = 3.25$. The direction of adjustment of Δt is important to note. In every case, the optimum Δt is less than the observed Δt, indicating that the standard linear model predicts convergence to equilibrium that is faster than the observed convergence.

TABLE 11

R-SQUARES FOR ADJUSTED TIME SCALE

	Wave 1 Forecasts Wave 3				Wave 2 Forecasts Wave 3			
	Female Black	Female White	Male Black	Male White	Female Black	Female White	Male Black	Male White
AP	.285	.495	.396	.500	.386	.541	.378	.493
EEP	.597	.599	.502	.643	.602	.643	.613	.773
OEP	.524	.641	.518	.702	.564	.686	.567	.800
EE	.384	.599	.495	.657	.531	.584	.584	.671
OE	.422	.538	.494	.636	.515	.576	.502	.743

NOTES: Abbreviations of variables are: AP = academic performance, EEP = educational expectation of parents, OEP = occupational expectation of parents, EE = educational expectation (of of youth), OE = occupational expectation (of youth).

It is imperative to distinguish between the R-squares achieved by adjusting the time scale and those observed from the original application of

---

30. A numerical routine named STEPT, written in FORTRAN by J.P. Chandler was used to find the optimum Δt. This program works well for finding a minimum of nonlinear equations for which algebraic solutions do not exist or are difficult to find. The program can be obtained from the Quantum Chemistry Program Exchange, QCPE Program No. 66, Chemistry Department, Indiana University.

the model. The latter are forecast R-squares in the exact sense, because no parameter estimates depended on information contained in the data to be forecasted, i.e., the wave-three endogenous variables. In contrast, the time scale was adjusted post facto to maximize the accuracy of estimation of the wave-three data, just as regression coefficients are calculated after the fact to maximize the accuracy of estimation.

Nevertheless, if the information gained from this study could be used to find a formula for adjusting the time scale, the adjustment could be incorporated into forecasting techniques applied to a new data set. The simplest adjustment is to multiply the observed Δt by a fractional constant. In the present data that constant which tends to maximize R-squares across measurement methods and race-sex subgroups is .43 (extrapolated from table 12). To afford the reader some sense of the stability of this constant, table 12 shows the optimum Δt by method, race, and sex, and by observed Δt. The table also shows the ratio of optimum Δt to observed Δt. This ratio is remarkably stable across measurements, sex and race, and observed time interval; thus, one is entitled to some confidence that adjusting the time scale would improve forecast accuracy in future research.

Given the exploratory nature of the present study, these results offer hope that refinement of the theoretical model could generate forecasts that are substantially more accurate than the "naive" model of no change or the "naive" single-equation model. To lend some sense of the improvements that could be expected, table 13 displays R-squares in which the theoretical model includes adjustment for optimum Δt, and the "naive" model is the model of no change. Although the R-squares in table 13 remain small, they are all positive and reveal modest to good improvement over the corresponding values in which the natural time scale was used (see table 2). It is obvious, however, that substantial theoretical work remains. Given the experience reported in this chapter it appears that the best strategy would not involve indiscriminant incorporation of more variables into the model. Careful measurement work will be needed, and efforts to complicate the mathematical model of the process to accommodate adjustment of the time scale seem warranted.

Summary and Commentary

This chapter presents estimates of the effects that parents and their teenage children have on each other in the development of career expectations for the youth. Effects of socioeconomic background and mental ability also are examined. A mathematical model of these effects is advanced; the model is intended to capture, in part, the dynamics of the process of career development over time. A central feature of the empirical analysis is to submit the model to a test whereby sophomore and junior career expectations are combined with the model to forecast career expectations of seniors; the model is evaluated by the accuracy of these forecasts. As theoretical models have seldom, if ever, been submitted to forecasting tests in past research, it was difficult to anticipate the

TABLE 12

OPTIMUM TIMES BETWEEN OBSERVATIONS AND RATIOS OF OPTIMUM TO OBSERVED TIMES

Wave One Forecasts Wave Three, Observed Δ t = 3.25

Subgroup	SP	CL	Mixed	Average	Row Mean
Female Black	1.142 .351	1.325 .408	1.477 .454	1.330 .409	1.319 .406
Female White	1.539 .474	1.449 .466	1.538 .473	1.376 .423	1.476 .454
Male Black	1.451 .446	1.381 .425	1.330 .409	1.478 .455	1.410 .434
Male White	1.404 .432	1.317 .405	1.300 .400	1.470 .452	1.373 .422
Column Mean	1.384 .426	1.368 .421	1.411 .434	1.414 .435	1.394 .424

Wave Two Forecasts Wave Three, Observed Δ t = 2.00

Subgroup	SP	CL	Mixed	Average	Row Mean
Female Black	.705 .353	.759 .380	.697 .349	.730 .365	.723 .362
Female White	.957 .479	.944 .472	1.034 .517	.825 .430	.940 .470
Male Black	1.019 .510	1.015 .508	.904 .452	1.011 .506	.987 .494
Male White	.082 .401	.983 .492	.771 .386	.888 .444	.861 .431
Column Mean	.871 .436	.925 .463	.852 .426	.864 .432	.878 .439

NOTES:

1. Optimum times appear above slashes, and ratio of optimum to observed time appears below.
2. Column abbreviations are: SP = subjective probability measurements, CL = checklist measurements, Mixed = educational expectation, measured by checklist method and occupational expectation by subjective probability, Average = both educational and occupational expectations measured by averaging SP and CL.
3. Ratios under row and column means are ratios of average optimum times to observed times rather than averages of the ratios.

TABLE 13

R-SQUARES FOR OPTIMUM TIME INTERVALS AND NAIVE MODEL OF NO CHANGE

Endogenous Variables	Wave 1 Forecasts Wave 3				Wave 2 Forecasts Wave 3			
	Female Black	Female White	Male Black	Male White	Female Black	Female White	Male Black	Male White
AP	.342	.441	.466	.343	.093	.022	.189	.179
EEP	.319	.208	.122	.167	.180	.076	.061	.146
OEP	.160	.215	.168	.159	.149	.114	.080	.048
EE	.235	.235	.283	.297	.126	.194	.280	.209
OE	.229	.208	.253	.237	.135	.131	.177	.103

NOTE: Abbreviations of variables are: AP = academic performance, EEP = educational expectation of parents, OEP = occupational expectation of parents, EE = educational expectation (of of youth), OE = occupational expectation (of youth).

results, especially in view of the fact that it is algebraically possible for forecasting "R-squares" to be negative. One of the most striking findings of the study, therefore, is the high level of accuracy with which senior-year career expectations can be forecast. Forecasting R-squares range up to .779 and average .726 for the career expectations (EEP, OEP, EE, OE) of white males using the averaged measurements and time-two data as input. These results seem remarkable in view of the fact that regression R-squares for individual-level data seldom range nearly this high.

Investigation of the reasons for the high forecasting accuracy revealed an interesting but simple explanation. Most of the predictive accuracy can be attributed to stability over time of each of the endogenous variables (AP, EEP, OEP, EE, OE). Forecasts generated by the mathematical model were more accurate than the simple hypothesis of no change, but not by a large margin. It should be noted, however, that there is no necessary reason that the mathematical model be even as accurate as the hypothesis of no change. The fact that it was somewhat more accurate indicates that it did capture the stability in career expectations and accounts for some of the change as well. Thus, in view of the exploratory nature of this report, the results are encouraging indeed. The data exhibit substantial regularity, and that regularity is manifest in the dynamic model. Thus, there is ample reason to expect that refinements of theory and method could improve the results.

Two strategies for improving the model were investigated briefly. First, the basic model was expanded by including peer-expectation variables and income-expectation variables as linear components. The results of both inclusions were not encouraging. The peer and income variables could not be forecast accurately, and neither set of variables improved the forecasts of the endogenous variables in the basic model (AP, EEP, OEP, EE, OE). Secondly, the forecasting equations were adjusted experimentally by altering the time scale. When the time scale is stretched, the R-squares for all variables in the basic model increased by five to six points. This observation suggests that efforts to adjust the mathematical specification of the process might bear fruit. Consequently, the subsequent chapter develops two extensions of the model. One extension attempts to link speed of change to uncertainty of expectation and is fairly closely related to the observations in this chapter of the effects of adjusting the time scale. The second extension proposes a strategy for including sociological, economic, and vocational psychological theory in the model.

Empirical investigations with structural-equation models tend to overinterpret the values of specific estimates of effects. In view of fairly high sampling variability and pervasive unresolved issues of identification, only highly tentative interpretations are justified. This warning applies particularly to the present work with differential equations, since knowledge of sampling variability is sparse and experience with differential equations is limited. Nevertheless, there are some intriguing patterns in the estimates of effects that one would be remiss to overlook.

In no sex-race subgroup do the exogenous variables (SEB, MA) exhibit large direct effect on changes in the career-expectation variables (EEP, OEP, EE, OE) or academic performance. In contrast, for whites socioeconomic background exercises the strongest total effects on the equilibrium values of career expectation variables, and mental ability manifests the largest influence on academic performance. Indirect long-run effects account for most of the total effects, thus supporting the basic theoretical view underlying the Wisconsin model, viz, that social-psychological processes account for most of the association between socieconomic background and socioeconomic attainment. On the other hand, among blacks of both sexes, SEB was not the dominant influence on long-run career expectations, and the hypothesis that sociol-psychological processes intervene between the exogenous variables and equilibrium levels of expectation is not well supported.

For male whites the pattern of effects among the career expectations and academic performance match fairly closely theoretical predictions from the social-psychological view of status attainment (Haller, forthcoming). The parental-expectation variables exercise the dominant effect on the matching expectation of the youth. That is, EEP has a strong effect on EE, and OEP has a strong effect on OE. The feedback from youth to parent is not strong, though the occupational expectation of male whites exercises a modest effect on their parents' occupational expectation for them. In the other sex-race subgroups the observations do not match theoretical expectation nearly so well, however. For female whites, OEP has a strong effect on OE, and EEP has a strong influence on EE, but EE shows a dominant effect on EEP. The impact of EE on EEP is repeated for blacks of both sexes. For blacks, parental influence on youth appears less strong than the influence of youth on their parents. Also, for male blacks, the educational expectations of the youth play a pivotal role in shaping occupational expectations; whereas, for the other groups OE tends to affect EE more strongly than the reverse.

In all four groups, parental expectations manifest strong feedback on each other; EEP affects OEP, and OEP affects EEP. Also, in all four groups educational expectation tends to influence academic performance as much as the reverse; this feedback contradicts the usual assumption in the research literature.

The overall impression from these results is that of somewhat erratic variability of effects across subgroups. Certainly, it would be a mistake to place undue confidence in any single comparison. Nevertheless, some tentative generalizations do emerge. Blacks seem to be less influenced by parents than whites. Feedback is the rule rather than the exception. In all groups feedback from youth to parents is evident, but the pattern of feedback does vary across race and sex.

Comparisons between the subjective-probability and checklist methods of measuring career expectations revealed that the subjective-probability method worked better for occupation than it did for education and income expectations, and better for whites than for blacks. When subjective probabilities for occupation and checklist measures for education were used forecasts tended to be as accurate or more accurate than when only nonsubjective-probability measurements were used. By a wide margin, best results were observed when the checklist and subjective-probability measures were averaged, however.

The subjective-probability measures do accommodate respondents who are unsure of their future careers, and do so in a conceptually pleasing way. As reviewed in chapter 3, they also yield information about the level of uncertainty. Measurements derived from the subjective probabilities do generate accurate forecasts, but this is more true for occupational expectations than for educational expectations. Only limited experimenting with the technical details of subjective probability measures could be carried out for this research project; combine this fact with the theoretical appeal and empirical potential of the measures, and further measurement work with the subjective probabilities seems warranted.

For measurement of education and income with subjective probabilities, interviewers reported some apparent difficulty on the part of respondents in determining what was expected. This fact may account for the superior performance of subjective probabilities with the occupational data. With income and education, then, work in developing instructions that are easily understandable is indicated. It may be necessary to present respondents with examples that are given orally by interviewers. With occupational data, the most obvious refinement entails simplification of the list of occupations. The list used in the present work is an ad hoc collapsing of detailed occupations for the 1970 census. Although the list needs to be simplified, it is essential to keep in mind the conceptual requirement that it be exhaustive (or nearly so) of all occupations youth consider as likely outcomes for themselves. Also, the list must reflect a good range of status levels and should not mask differences on other dimensions, such as sex stereotyping, or service to society. The call for additional measurement work applies especially to income expectations. Accurate measurement of attitudes does require extensive research effort. As Haller has written:

> ... while a few attempts have been made to employ variables measuring the psychological isomorphs of income, it would appear that no such instrument of demonstrated reliability and validity has yet been published for use among young people who have not yet taken regular jobs. It seems unlikely that adequate measures of such variables can be contrived except by devoting considerable research effort to doing so, more or less as was done for educational and occupational status variables and their psychological isomorphs.
>
> (Haller, forthcoming: 15-16)

Of course, the measurement work should not be devoted solely to subjective probability methods. Comparisons of different formats is essential. Three seem particularly worthy of investigation: (a) the conventional checklist method, (b) subjective-probability methods, and (c) the Galileo method of distance (Woelfel and Fink 1980).

Of course given the tentative nature of the present research, it would be premature to base strong policy recommendations on it. Several policy considerations do emerge from the results, however. First, among whites the results of this research indicate that career expectations eventually will settle into levels determined largely by socioeconomic background rather than ability. Given the strong impact of expectations on attainments documented in other research, this observation indicates a need for sustained effort to encourage youth of high ability to maintain expectations commensurate with that ability. The tendency for expectations to gravitate toward the parental attainment level, however, emphasizes the need for continual guidance to maintain high expectation levels. On the other hand, adjustments to the time scale implied a slowing down of change so that early intervention, say prior to the teenage years, is indicated.

The results here lend only modest support to the view that involvement of parents in guidance programs might be an effective methodology. Among white youth, parents do influence their children's expectations, but the youth also influence their parents. Among blacks, however, parental influence is even less clear, and involvement in school programs may not be effective. It may be quite desirable on other grounds, however. The need to work with groups of youth rather than individuals, in order to make use of peer influence, is questionable. Based on the present results, peers do not exercise a critical influence on youth's expectations.

Finally, the poor forecasting results with income expectations suggests that youth may not have complete information about the amount of income required for different levels of living and the connection between income, occupation, and education. Programs to improve that information may be useful.

CHAPTER 5

THEORETICAL EXTENSIONS

The linear model drawn from status-attainment theory is a good springboard for determining a realistic representation of the dynamics of career development, but it is too simplistic. It omits obvious aspects of the process such as the fact that uncertainty is a major feature of early expectations, nonstatus dimensions of occupations play a role in selection of a job, and individuals engage in some kind of rough maximizing process in making their career choices. Further, the simplistic model drawn from status-attainment theory generates forecasts that are just accurate enough to be tantalizing: they show indisputable signs of regularity, but are not quite accurate enough to be of practical value. The fact that retarding the time scale improves substantially the value of R-squares and this improvement is stable across measurements and subgroups offers real hope that patient theoretical work could generate a much improved model.

This chapter draws on psychological, economic, and sociological theory to suggest strategies for expanding the model to represent processes related to uncertainty, realism, and maximizing, and for incorporating nonstatus dimensions of occupations. The first section of the chapter addresses theoretical adjustment of the time scale and its possible connection to uncertainty and vacillation over time. The second section combines the economic model of maximizing utility with sociological and psychological theory about multidimensionality of occupations.

The developments in this chapter are highly exploratory. The theoretical models proposed require technical work in computer application that could not be carried out for this report. Nevertheless, the problems are, in principle, solvable. Undoubtedly, empirical test and/or further reflection on the extensions of the model proposed here will indicate needed changes. The extensions are presented as a stimulus to the needed reflection and empirical work.

Time Scale Adjustments and Vacillation

The results of adjusting the time scale show a similarity between the continuous process of changing career expectations and discrete changes to which Markov chains are applied. Blumen, Kogan, and McCarthy (1955) showed that job shifts fail to follow a stationary Markov process due to excessively large entries in the diagonals of multiple-period transition matrices. They proposed the "mover-stayer" model to account for the observation. The mover-stayer model was generalized in an ingenious fashion by Spilerman (1972). The mover-stayer model and Spilerman's generalization posit population heterogeneity regarding propensity to move. A similar strategy could be adopted for the career-expectation system. The first step would be to postulate time dependence in the coefficients of the model. An obvious hypothesis is that the responsiveness of each variable to the other variables slows down with time. This idea reflects roughly the idea of "crystallization" given prominent attention in the vocational psychology literature (e.g., Super 1957). Once the basic model of time dependence is established, one may posit variation among individuals regarding the degree of time dependence. The degree of time dependence may be associated with demographic variables such as race and sex or with career planning variables such as degree of certainty of career expectation. The idea that the time dependence is associated with characteristics of individuals is an obvious analogy with the population hetereogeneity proposed in the mover-stayer model.

A useful beginning for developing a theory incorporating time dependence is contained in the following generalization of the basic model:

$$(24)\quad d\underline{y}/dt = f(t)[\underline{Ax} + \underline{By}] + \underline{u}$$

where f(t) is a scalar function of time. To reflect population heterogeneity, of course, one must postulate that some parameters of the function f(t) vary from person to person. To express the idea that the diagonals of $\underline{B}^*$ should decline more slowly than implied by the original model, one can require that f(t) increase more slowly than the time units ($0 \leq df(t)/dt \leq 1$). The definite integral associated with (24) is:

$$(25)\quad y_1 = (e^{\underline{B}[F(t_1)-F(t_o)]}-I)\underline{B}^{-1}\underline{Ax} + e^{\underline{B}[F(t_1)-F(t_o)]}\underline{y_o}$$

where $F(t) = \int f(t)dt$. This result provides a prediction and estimation equation. The revised model can be viewed as a generalization of the stationary model achieved by transforming the time scale. Presumably, f(t) and F(t) would contain parameters; these parameters might be viewed as dependent on individual characteristics, such as race, sex, or uncertainty. In the empirical analysis on stretching the time scale, F(t) was estimated roughly to be .43t (implying f(t) = .43--see table 12), and there was little variation by sex and race. If the constant multiplier (.43) were allowed to differ by sex and race, then one has an example of the parameters of F(t) differing according to individual characteristics. Inspection of table 12, however, suggests that little is gained by varying the multiplier across subgroups.

An appealing theoretical idea is to connect vacillation in level of expectation over time to uncertainty at any given point in time. If f(t) were some sort of oscillating function such as the sine function, and the amplitude and frequency were functions of uncertainty, the desired result would be achieved. Although limited resources do not permit empirical investigation of this idea for the present report, some sense of the operation of vacillation can be achieved by graphing an example from the present analysis, as explained in the next paragraphs.

The fact that two of the eigenvalues of $\underline{B}$ in each subgroup are complex numbers (see table 6) indicates some degree of oscillation in the time path of the endogenous variables. Little oscillation is apparent in any time paths graphed in figure 5, however. Absence of apparent oscillation is due to the small magnitude of the imaginary parts of the complex eigenvalues. However, the estimate of the imaginary part of the eigenvalues of $\underline{B}$ depends on taking the principal branch of the logarithm of the corresponding eigenvalue of $\underline{B}^*$ (the matrix of cross-lagged regression coefficients). If γ_R, γ_I are the real and imaginary parts of γ, with γ an eigenvalue of $\underline{B}$, and λ_R, and λ_I are the corresponding eigenvalue, real and imaginary parts for $\underline{B}^*$, then the following relations hold:

$$\gamma = \gamma_R + \gamma_I \iota = \ln\lambda/t \quad \text{(eigenvalue of } \underline{B})$$

$$\gamma_R = [\ln(\lambda_R^2 + \lambda_I^2)]/t \quad \text{(real part)}$$

$$\gamma_I = [\tan^{-1}(\lambda_I/\lambda_R) + k\pi]/t \quad \text{(imaginary part)}$$

where $\iota^2 = -1$, k is any integer, and t is the length of the time interval between measurements. The principal branch of $\ln \lambda$ is found by setting k to zero. Other solutions are just as valid mathematically, however, and lead to erratic oscillation of the endogenous variables over time. To illustrate, figure 6 plots alternative time paths of occupational expectation for a hypothetical black female youth. Three assumptions about the value of k are included. The first assumption is that $k = 0$ for both complex eigenvalues. The second assumption is that $k = 1$ for the first complex eigenvalue ($\gamma = -.451 + .104\iota$), and $k = -1$ for the second complex eigenvalue ($\gamma = -.451 - .104\iota$). The third assumption reverses the signs of k ($k = -1$ for the first complex eigenvalue, and $k = 1$ for the second). The value of k is zero for all real eigenvalues.

The two time paths for nonzero k exhibit erratic fluctuations, but note that all three curves pass through the same point at time-one (.625) and at time-two (1.25), marked by asterisks on figure 6. This fact emphasizes the inability to distinguish between the three alternatives with only two time points.[31]

---

[31] The fact that the spacing between waves of data collection are not equal in length allows one to make meaningful comparisons between forecasts with varying values of k. The comparisons are not tabulated in this document, to save space. In brief, of the comparisons made, $k = 0$ for all eigenvalues yielded far superior forecasts to other values of k.

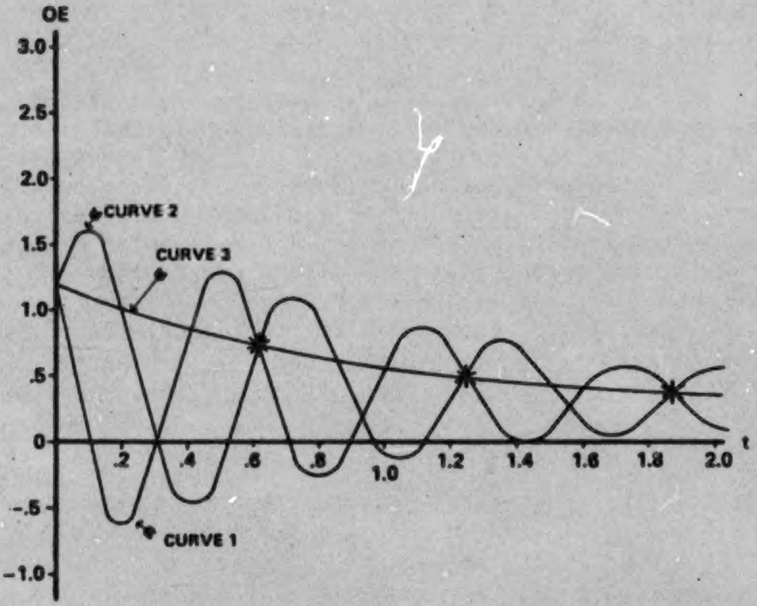


Figure 6. Time path of occupational expectation for one individual female black.

NOTE: For Curve 1, the principal branch of the logarithm for complex eigenvalues was used; for Curve 2, values of K of −1, 1 were used respectively for the first and second complex eigenvalues; and for Curve 3, values of K of 1, −1 were used respectively for the first and second eigenvalues, where the order of eigenvalues matches the listing in Table 6.

The graphic portrayal of oscillation does convey the image of a youth who cannot decide about the expected levels of achievement, but technical features of this method of generating oscillation prevent it from representing a theoretically adequate model. The main difficulty is that k can take on only integer values, yet controlling parameters representing the connection between vacillation and uncertainty must be allowed to assume fractional values. Also, the degree of vacillation in different variables probably is governed by different parameters; whereas, the values of k govern oscillation in all the variables.

This discussion suggests that a sine function be attached to each differential equation in the model and its amplitude and frequency be determined by uncertainty that is specific to each endogenous variable. The subjective-probability measures yield appealing uncertainty indexes that could serve this purpose. The model implied by these considerations presents considerable difficulty in the numerical calculations, however. The differential equations probably would have no algebraic solution. Numerical integration is impossible without knowledge of the parameters of the model. A solution might be found by inserting estimates of the parameters, generating predicted values by numerical integration, calculate a mean-square error, and use the STEPT program cited in footnote 10 of chapter 4 to minimize the mean-square error. This method would probably require lengthy calculations, however.

Multidimensional Occupations and Utility Maximizing

The multidimensional character of work has been noted repeatedly in a variety of theoretical settings (Spenner 1979; Spaeth 1979; Tolbert, Horan, and Beck 1980, Holland 1973; Goldthorpe and Hope 1972; Klatsky and Hodge 1971; Mortimer, 1974). A useful classification of dimensions of occupations is given by Temme (1975); he proposes three types: (a) routines, (b) requisites, and (c) rewards. One reason for the heuristic value of Temme's classification is that it captures three probable patterns of influence of occupational characteristics on the utility derived from an occupation. Rewards are comprised of occupational outcomes that fairly universally are considered desirable, ceteris paribus. Examples include occupational status and income. Routines include occupational features that some persons consider positive and some consider negative. Examples include degree of working with data, people, or things, and the six Holland types. Requisites describe personal resources, such as educational level or physical strength, necessary to perform the job at an acceptable level of competence. Job characteristics that do not readily fit into one of Temme's three categories also are important. Several examples come to mind: degree of personal autonomy on the job, level of social power of incumbents, level of social service performed on the job, sex stereotyping of the job, job security, and substantive complexity of the work (Kohn and Schooler 1978).

The point here is not to develop a classification of job characteristics. Rather, it is to point out that a variety of job characteristics influence the desirability, or utility, of a job. The degree and direction of this influence for a given job characteristic may differ from person to person, however. The model of interpersonal influences on development of occupational expectation relies on only one dimension of occupations: status. This appears to be a serious shortcoming of the model. While it is impossible in this report to develop and test a completely specified model of occupational expectation including nonstatus characteristics, some interesting suggestions can be offered.

An intriguing strategy for developing such a model is to combine the economic model of choices with the subjective probabilities for occupational attainment. The basic idea is to connect the subjective probabilties to utility by positing that subjective probability for entry into each job is a function of the distance between the actual (or perceived) characteristics profile of the specific job and an optimum job profile--that is the job profile for the individual that yields maximum utility subject to constraints implied by job "requisites." To be specific, suppose that subjective probabilities could be approximated by the following functional form

(26) $\ln p_j = a - bd_j^2, b > 0$

where p_j is the subjective probability for the jth occupation, d_j is the Euclidean distance between the observed and optimum job profiles, and a and b are empirically determined constants. The Euclidean distance is defined by the standard formula so that (3) becomes

(26a) $\ln p_j = a - b\sum_k(x_{jk} - c_k)^2, b > 0$

where x_{jk} is a measure of the level of job characteristic k on job j (e.g., income or average status for job j), and c_k is the optimum level of characteristic k subject to all the reality constraints that are imposed.[32] Taking antilogs on both sides of (3) yields:

(27) $p_j = Ae^{-b\sum_k(x_{jk}-c_k)^2}, A = e^a$

which is a special case of the normal distribution, except that it is truncated due to the limited range on the x_{jk}.

Given measurements on each occupation for all the x variables (e.g., Duncan SEI scores attached to each occupation), it is possible to estimate empirically the vector of optimum job characteristics, c_k. For each individual, form a mean-square error:

(28) $MSE_i = \sum_j[p_j - Ae^{b\sum_k(x_{jk} - c_k)^2}]^2$

where MSE_i is the mean-square error for the ith individual. Although it is fairly clear that (28) could not be solved algebraically for the unknown parameters, a, b, c_k, numerical solution should be routine.

The rationale behind the optimum characteristics vector can be built up from utility theory. Assume a conventional form to represent the utility one derives from a profile of job characteristics:

(29) $u = \alpha_0(x_1^{\alpha_1} \cdots x_K^{\alpha_K})$

where u is utility, the x_k are job characteristics, and the α_k are constants. (Equation (29) takes the same algebraic form as the Cobb-Douglas utility function.) The object is to maximize utility (u), but there are constraints. For simplicity, assume a single linear constraint function:

(30) $0 = y + \sum_k b_k x_k$

---

[32] Of course, given no constraints, the more income, status, and so forth, the better. With constraints, however, it is possible to think of an optimum income that balances effort against payoff. This is the classic labor-leisure choice in contemporary economic theory.

where y is educational level for each person, the b_k are constants, and the x_k are the job characteristics. Here y is analogous to total income in the theory of consumer choices, and the b_k are analogous to prices.[33] It would be possible to take regression coefficients derived from national data as estimates of the "prices." The regression would have education as the dependent variable and the job characteristics as independent variables. Of course, in practice, there probably are several constraint functions such as (30), but these could be incorporated into the model without undue difficulty.

The c_k estimated from equation (28) could be inserted into (29) as the x_k. Then maximizing (29) subject to the constraint in (30) permits calculation of the relative magnitudes of the α_k:

$$(31) \qquad \frac{\alpha_k}{\alpha_k'} = \frac{b_k c_k}{b_k' c_k'}$$

Since the α_k are elasticities of utility with respect to job characteristics, equation (31) shows the ratio of elasticity of characteristic k to that for k' to be the ratio of the total "purchase cost" of obtaining the optimum level of chracteristic k to that for k' (where total "cost" is the "price" times quantity: $b_k c_k$). From equation (31), then, one learns that the quantity $b_k c_k$ supplies information about each individuals' personal emphasis on job characteristic k in determining the payoff obtained from occupations.

For any particular individual, it is unlikely that the constraint in equation (30) will be exactly satisfied if the c_k calculated from (28) are substituted in for the x_k, and the level of educational expectation is substituted for y. The degree of departure of (30) from zero could be interpreted as an index of realism.

The foregoing development accomplishes several theoretically pleasing results. It applies the standard economic model of optimizing choices to selection of jobs. Since jobs comprise a categorical variable and the economic model applies to selection of quantities, it was necessary to translate categorical jobs into quantities. This was accomplished by assigning a profile of job characteristics to each job. The profile contained important job features identified in economics (income), sociology (e.g., status), and vocational psychology (e.g., Holland's six types taken as quantities). Also, the model gives interesting and potentially concrete meaning to the vocational psychology concept of realism of expectation.

In addition, important processes described in nontechnical theory are implicit in the model. There are interesting parallels between the main ideas in the model and Holland's (1973) notion of matching a personality profile to a job profile. First, the optimum vector c_k revealed by each respondent's pattern of subjective probabilities could be interpreted as a partial personality profile, thus reflecting Holland's basic theoretical assumption that job preferences are manifestations of personality. The connection is especially close if the six Holland types form part of the job-characteristics profile. Secondly, the concept of person-occupation congruence stated by Holland is expressed in the model by the hypothesis that the subjective probabilities are a function of the distance between the job profile and the individual's personal optimum profile.

---

[33] Several economic models of occupational choice have appeared in publication. A paper by Annable and Fruitman (1976) is probably the closest conceptually to the model proposed here.

The utility model is an equilibrium model, since there is no reference to change over time in the equations. Further, except for the constraint equation, no connection between occupational expectation and other important aspects of careers is built in. These are important limitations, but serious work on them cannot be undertaken in this report. The following paragraph is confined to commentary on the probable relationships between expansions of the model and theoretical ideas in the literature.

Suppose that the subjective probabilities change over time. These changes, according to the model, would result from changes in the optimum job-characteristics profile that, in turn, would come about by changes in the parameters of the utility function, i.e., the exponents α_k in equation (29). An interesting, though technically difficult, strategy for specifying a more comprehensive model is to connect the α_k to other variables such as education, socioeconomic background, and parental expectation variables. Showing the α_k as a function of SEB and parental-expectation variables might reflect Kohn's (1969) idea that parental job characteristics affect parent's personality which, in turn, affects child rearing--in this case occupational socialization in the home.

Woelfel and Haller's (1971) concept of filter categories may also be implicit. According to Woelfel and Haller, filter categories are sets of attitude objects (e.g., sets of occupations) that have been classified as belonging to the same class. A significant other may affect ego either by direct impact on an attitude or by shaping filter categories. Although Woelfel and Haller do not say so, filter categories undoubtedly are defined by a particular profile configuration on a roughly specified set of variables that describe the attitude object (e.g., characteristics profile on occupations). Presumably, objects are classified by placing them into filter categories so that the discrepancy between the profile on the object and the profile defining the filter category is minimum. It seems apparent, then, that changing filter categories occurs by changing the list of variables in the characteristics profile and/or by adjusting the weights (α_k) assigned to each variable. The application here is that youth may assign occupations into rough similarity groups, that is, filter categories. Adjusting the optimum characteristics profile by changing α_k would affect the definition of these categories. Whether people actually create discrete categories for themselves, of course, is an empirical question. It may be that at least some persons carry out their evaluations with approximations to continuous profiles, bypassing the categories.

CHAPTER 6

SUMMARY, CONCLUSIONS, AND POLICY IMPLICATIONS

This volume reports the results of a three-year longitudinal study of the career expectations of teen-age youth and their parents. The purpose of the study was to test a mathematical model of developing career expectations that explicitly accounts for the dynamics of career development and allows causal feedback among career expectations of youth and their parents.

The Model

There are seven variables in the basic model examined in this report: socioeconomic background (SEB), measured mental ability (MA), academic performance (AP), educational expectation held by parents for their teen-age child (EEP), occupational status level of expectation held by parents for their teen-age child, educational expectation of the youth for self (EE), and occupational expectation of youth for self (OE). These variables are classified into two types. The exogenous variables are SEB, and MA and the endogenous variables include AP, EEP, OEP, EE, and OE. The mathematical model is a system of linear differential equations in which changes in the five endogenous variables are postulated to be linear functions of the exogenous variables and each of the five endogenous variables. The form of the model is analogous to static conceptions of the same process written as path models. Sociological theory of interpersonal influences on career expectations forms the substantive basis for the model. The authors are aware of the limitations of this formulation, however, and propose concrete steps for drawing on multiple theoretical perspectives to improve correspondence between the model and the actual process.

Method

Information needed to measure all variables in the model was collected from a sample of some 600 youth and their parents. Interviewers were dispatched to respondents' homes first when the youth were high school sophomores, and again each year thereafter for a total of three times. The youth and one or both parents completed questionnaires at each of these sittings. Information gathered during the first two occasions was used to estimate unknown parameters of the model and to forecast the career expectations of students and their parents at the third time point. Accuracy of these forecasts were used to evaluate the model.

Findings

The accuracy of the forecasts achieved by the model is remarkably high. Forecasting R-squares range as high as .78 and average as high as .63 among male whites; among blacks they average nearly .50 and among female whites, .54. These results reveal regularities in developing career expectations that are represented by the model. This is an important finding. Regression R-squares are based on ex post facto estimation of regression coefficients to maximize the predictability; hence, they do not assess forecasting accuracy. The present observations show that straightforward extensions of current theoretical conceptions can be used to supply accurate forecasts.

On the other hand, analysis of the reasons behind the forecasting accuracy shows that it is largely, though not entirely, due to stability of the career expectation variables. A "naive" model of no change in the endogenous variables yields forecasts that are nearly as accurate as those generated by the theoretical model. This observation led to some experiments to determine if the accuracy of forecasts could be improved.

One revision of the basic model was to adjust the time scale to maximize R-squares. These adjustments gave strong evidence that the model implies change that is faster than observed change; stretching the time scale improved the R-squares by five to six hundreds. Another type of revision was to incorporate peer attitudes and income expectations as linear components in the basic model. Forecasting accuracy of the peer and income variables was dismally low, and neither class of variables improved the forecasts of the original five endogenous variables (AP, EEP, OEP, EE and OE).

Although the direct effects of socioeconomic background (SEB) and mental ability (MA) on changes in the career expectation variables and academic performance were small, the total effects in the long run were substantial. For whites SEB had a pronounced effect on the equilibrium levels of the career expectation variables, and mental ability did not. The long-run total effects on academic performance was dominated by mental ability, however. It is an interesting methodological note that these results contrast with reduced-form estimation of long-run effects under the implicit assumption that equilibrium has already been achieved. Also, for whites, the indirect effects of SEB and MA operating through interpersonal processes account for most of the total effects. Among blacks, these results were not replicated. Mental ability tended to have a stronger effect than SEB, but the coefficients of long-run effects exhibited somewhat erratic variation across equations. Indirect effects did not systematically account for a large part of total effects.

Contrary to assumption in most empirical research in the past, substantial feedback was observed among the endogenous variables. Perhaps the most interesting class of feedback effects is that between parents and children. In every sex-race subgroup, the children's expectations exhibited effects on the expectations held for them by their parents; this was particularly true among females and blacks. In fact, in every group except male whites, at least one instance of youth influencing parents more than the reverse was observed. This pattern was evident enough among blacks to suggest that parents may not exercise a strong influence on the development of career expectations among black youth.

In every sex-race group, the impact of EE on changes in AP tended to be as strong or stronger than the reverse effect. This observation contradicts the usual assumption in crosssectional models. However, this outcome must be checked with data in which grades are taken from school records rather than from the students.

Parental expectations (EEP, OEP) in every case manifested strong feedback on each other. Analogous feedback was not present consistently for the youths' expectations (EE, OE). Among female blacks, OE influenced EE more than the reverse, but this pattern was reversed among male blacks. Among whites EE and OE did not have strong effects on each other. Rather, parental expectations tended to dominate change in white youths' expectations.

Extensions

Because of the success of adjusting the time scale in improving predictability and failure of expanding the model by incorporating more variables, discussion of theoretical extensions of the model focused on mathematical respecification. The respecifications did, in fact, include several variables not in the basic model, but they did so in a context of trying to improve the description of the process by altering the form of the equations.

Two extensions were developed in chapter 5. The first extension tied the speed of changing career expectations over time to uncertainty. Vacillation was represented by a sine function whose parameters were connected to uncertainty. The subjective-probability measurements developed for this study contain appealing indexes of uncertainty that could be used in empirical study with the revised model.

The second extension of the basic model was proposed in which occupational choice was viewed as a utility maximizing process. By connecting the subjective probability for entry into a given occupation to its utility, the economic model can be applied to the categorical variable, occupation--even though the economic model is designed for choices of quantities. The key to this representation of occupational choice lies with assigning a profile to each occupation. The occupational utility is determined by the goodness of fit between the occupational profile and one's optimum profile determined by the maximizing process described in microeconomic theory. Variables in the profile are drawn from sociology (e.g., status), vocational psychology (e.g., Holland's types), and economics (income). The model does, therefore, accommodate theoretical insights from three academic disciplines and, thereby, avoids the undue reliance on occupational status that characterizes sociological work. The model is not complete, however, because it is not dynamic, and because it does not connect occupational expectations to other variables in the basic model.

Of course the two extensions of the basic model proposed in chapter 5 do not begin to exhaust the need for further work on topics related to development of career expectations. There remains critical work in measurement of expectations. In particular, the empirical results in this study suggest that improved measurement of income expectations and of peer variables might be useful. Informal observation suggests that a mind set about economic consumption levels develops along with expectations about educational and occupational achievements, yet evidence reported in this volume based on income expectations does not support this view. Reorientation of measurement from income expectations to consumption expectations may improve the performance of the economic variables. Improved measurement of peer variables probably depends on adjusting sampling procedures so that all individuals in a school can be included. This procedure permits assessment of the milieu in which each respondent is located (see Haller and Butterworth 1960; Hout and Morgan 1975). If respondents were asked to identify a few of their friends, then expectations of those friends, as reported by the friends, could be used to assess the modeling influence of specific peers.

In addition to measurement work with income expectations, efforts to refine measurement of educational and occupational expectations are justified, especially with the subjective-probability measures. Refinement of instructions to respondents about how to use the subjective-probability items appears worthwhile. Also, experiments with alternative formats that do not use number lines may be useful. Finally, revision and shortening of the list of occupational titles would be desirable.

The differential-equation model of developing career expectations is an important improvement over previous representations in which time does not appear explicitly. Nevertheless, the application of differential equations reported here, including the extensions in chapter 5, ignore obvious features about timing of changes in career expectations. The attention of youth on topics related to their future careers occurs sporadically along the continuous time scale. Hence, it is a good hypothesis that changes in expectation levels occur at sporadic intervals--change is continual rather than continuous. Mathematical models capturing this idea will be difficult to develop and test. It may be that concepts in "catastrophe theory" (Zeeman, 1977) could provide useful conceptual foundation. Aspects of career development other than expectations also change abruptly. Examples include track in school (college preparatory, general, vocational), participation in athletics, leadership activities, and school clubs.

The differential-equation models implying continuous change, however, apply much better to developing career expectations than to changes in occupation and income of adults. Job changes obviously occur abruptly, and so do wage rates. Also, important career transitions such as labor-market entry, completion of schooling, and labor-market exit are abrupt changes that cannot be accurately modeled by differential equations. Theory of these changes ought to incorporate a model of adult expectations (Raelin 1980). These expectations must be combined with a description of characteristics of one's current job and of alternative jobs. Again, it might be possible to draw on catastrophe theory for the conceptual tools needed for connecting continuous variables with discrete events.

It may appear that standard statistical tools for combining continuous and categorical data, such as the analysis of covariance (ANCOVA) would supply useful conceptualization in the present context, but this does not appear to be the case. Statistical models such as ANCOVA are not easily converted into dynamic models in which the categorical variables are endogenous. For example, possible feedback effects between income and marital status of females cannot be represented as a differential equation, and it is difficult to imagine how such feedback could be modeled with explicit reference to continuous time. Yet, the process most certainly does occur over continuous time. The difficulty of developing the continuous-time mathematical model is true, not withstanding the fact that a statistical model relying on ANCOVA could easily be adapted to longitudinal data. The statistical model could not be adapted easily to forecasting. Because of the omission of explicit reference to time, forecasts would necessarily be limited to time points that were discrete multiples of the length of the measurement interval. Further, the ad hoc nature of adapting the statistical model to continuous-time forecasting probably would lead to very poor forecasting accuracy.

The work in this study has relied exclusively on the concept of expectation, as opposed to preference and aspiration. Closely related concepts such as these need to be carefully defined and incorporated into the model, or the reasons for exclusion ought to be explicit. (See Haller 1968; Kuvlesky and Bealer 1966; Lewin et al. 1944). The concept of expectation implies the most realistic judgment about future outcomes (Lewin et al. 1944). Therefore, it should yield the best prediction of future attainments. It is for this reason that the present work has focused on expectation. Preference is closely related to utility--what one would find gratifying if there were no constraints. On the other hand, aspiration implies a combination of preference, expectation and goal (again, see Lewin et al. 1944). The idea of effort seems implied with aspiration but not with the other concepts. Information about preference might be drawn from the utility model of expectations, by observing the elasticity coefficients in the Cobb-Douglas utility function (see chapter 5); however, the concept of aspiration does not appear in that model.

Haller (1968) has written a thoughtful piece on fruitful lines of inquiry related to the status-attainment process. One of the points he emphasizes is the need to study development of aspirations in young children. The results reported here are consistent with Haller's view. The fact that a "naive" model of no change is almost as good as the theoretical model suggests that much of the influence of the variables in the model occurs when the youth are in the pre-teen years. Study of young children, however, would require considerable attention to revision of measurement procedures.

Policy Implications and Applications

The most important policy implication of this study is that more attention needs to be devoted to development of career expectations of youth. Otherwise, youth's expectations tend to gravitate toward the socioeconomic levels of their parents, especially among white youth. Equity demands that the same attention be given to black youth--particularly since expectations have such an important impact on achievement. The fact that the model shows that changes in expectations induced early in one's youth tend to diminish by completion of high school reinforces the need for career guidance. The guidance must be continual to be effective.

A number of strong feedback effects from children to parents have been observed in the data. Combine these observations with the lack of manifest peer influence on changes in career expectations and one is led to conclude that involvement of significant others in career-development programs may not be critical. If youth are pursuaded to adjust their expectations, parents may accept the revised plans. It may be desirable, nevertheless, to involve parents in order to gain the benefit of parental experience.

The poor performance of income-expectation variables, including their low correlations with educational and occupational expectations suggests that students could benefit from exposure to information about the levels of income that can be expected from different occupations and the amount of income needed to sustain different levels of living. Parental experience with these matters could provide useful information for youth. Parental involvement could be as simple and practical as homework assignments for which youth have to consult their parents.

Potential application of the research to practical problems is not limited to policy implications of the findings accumulated to date. A theory of developing career expectations that yields good predictions of the time paths of career planning variables would provide a useful tool for assisting evaluation of guidance. The theory could be used to project important variables from the freshman or sophomore year in school to the time of graduation. Effectiveness of the career guidance could then be gauged by the extent to which desired results occurred that would not have occurred in the absence of the guidance. In most evaluations, random assignment to treatments is impossible. Thoroughly confirmed theory could serve as a partial substitute for random assignment. Even when random assignment is possible, the theory could be used to reduce the magnitude of the error variance in the classical experimental design, thus making it easier to detect effects of the guidance programs. This type of application, of course, will be more useful as better forecasting models emerge.

The study has developed a conceptually appealing method for combining into a single instrument measurement of the level of occupational and educational expectation with measurement of uncertainty about those expectations. The measurement methodology is based on respondents' "subjective probability" for attaining specified career outcomes. This conceptualization combined with the forecasting capability of the differential equation model offers an interesting potential application. The degree of uncertainty and level of expectation could be measured while the youth is a freshman or sophomore in high school and projections for level and for uncertainty of expectation made to the senior year. This information could be used by counselors to judge whether the youth is likely to crystallize career plans at an appropriate time. Such information might then enter into judgments about which students are most in need of career guidance.

It is also possible that the utility model of occupational expectation will produce information of interest in guidance settings. One could calculate routinely an index of "realism," a profile of optimum job characteristics (work values), and indexes of the degree of emphasis that youth place on different job characteristics. If combined with well documented theory, such information should be substantially better quality than what is currently available. Further, the information could all be calculated from one instrument collecting subjective probabilities for entry into various occupations. Respondent burden therefore would be low. Also, there is a certain appeal to the idea that information about realism of choice or work values could be determined by combining well-tested theory with response patterns on subjective-probability items. The idea is that youth may reveal their work values more fully in their expectation patterns than they do when asked directly to state those values.

As with all policy implications drawn from scientific inquiry, these implications must be viewed as tentative pending confirmation of the findings on which they are based. The need to verify findings of any particular study is particularly important when studying human subjects. This caution is due primarily to the high variability of human behavior.

Conclusions

This study is the first to propose and test a dynamic model of the process by which young people develop career expectations over time. A number of intriguing results have emerged from the empirical analysis; these are summarized in preceding sections of this chapter. But the most exciting features of the work undoubtedly stem from the potential for future research and application that are natural outgrowths of the current project.

Perhaps the most important ramifications of the study are related to the idea that we must take seriously the philosophy that scientific theory be tested by checking the accuracy of forecasts produced by the theory. The first implication of theoretical forecasting is that the theorist is forced to account for the dynamics of the process under study. Seen in dynamic perspective, a large part of contemporary social theory is, by implication, equilibrium theory. Most theories of career expectations fit this characterization, and those that do not are ad hoc; explicit incorporation of time into the models is absent. Thus the forecasting test stimulates more realistic theory.

The second implication of theoretical forecasting is that the potential for specific technical application of theoretical knowledge to practical problems is enhanced substantially. The most obvious application is to use the theory to forecast events that one wishes to predict. For example, the theory of career expectations proposed here could be used to forecast late high-school expectations with data collected from students as they enter high school. Such forecasts should provide school personnel with more useful information about student career plans than what would be available from students' current responses to questions about career plans. To the extent that theory could be improved, the forecasts would be increasingly useful.

At the present stage of theory, forecasts would not be sufficiently more accurate than the implicit hypotheses of no change to justify the expenses of generating them. They might be justifiable, however, in a package of research and development in which part of the expenses are viewed as research expenditures and part as development and application. A joint research and application project such as this might pay handsome dividends. It could combine the practical insights of school personnel with some of the most sophisticated research technology available.

Perhaps even more important than direct application of forecasting in practical settings is the use that could be made of concepts generated by theory that has passed rigorous forecasting tests. For example, if concepts of uncertainty and realism can be given clear technical meaning and used to improve the accuracy of forecasts, as suggested in this volume, then they could be used as diagnostic tools in school counseling with much more confidence than typical ad hoc measures.

One must, of course, recognize that the impact of technical applications suggested here will be of marginal importance on the conduct of career guidance in schools. It does seem essential, however, that dynamic theory of career development be exposed to the practical rigors of every day use. Over time, a feedback between practice and theory could be expected to produce both improved practice and improved theory. The iterative process certainly will require good judgment sympathetic understanding of each other's role on the part of the theorist and the practitioner.

The third ramification of theoretical forecasting is that one is stimulated to conceptualize effects by explicit reference to the length of the time interval between stimulus and outcome. In this volume, the concepts of total effect, direct effect, and indirect effect are so defined. The distinction between total effect and direct effect defined in dynamic context lends specific technical meaning to the often expressed opinion that lab experiments do not apply to the real world. Laboratory experiments occur in specialized settings that attempt to assess direct effects, to the degree that experimental control is feasible. Results of policy changes, however, occur in the field and approximate total effects of variables operating in an ongoing system. The sizable differences that are likely to occur between direct and total effects have been illustrated in this report.

The final implication of theoretical forecasting is that a definite criterion for evaluating theory is proposed. The impossibility of defending assumptions required to identify conventional structural equations plagues efforts to advance theoretical knowledge in nonexperimental research. It would be naive, of course, to suppose that forecasting tests supply a route to certain theoretical knowledge. What they do supply is an objective criterion that permits the iterative process of doing science to proceed.

The concept of subjective probability for achieving alternative career outcomes is a second potentially important contribution of this study. The empirical results reported in this volume show that the subjective-probability measurements combined with conventional methods may provide superior indication of career expectations. Moreover, the theoretical extensions in chapter 5 illustrate that the most important potential of the subjective probabilities may lie with the conceptual power that they afford. The model of uncertainty and vacillation proposed in chapter 5 depended on the concept of subjective probability. Likewise, the application of utility theory to occupational choice in chapter 5 depended in a key way on the concept of subjective probability.

It is concluded that the present study suggests some potentially important new ideas for the conduct of research on career development. Of the several feasible extensions two types would appear to be the most productive. First, the theoretical extensions related to uncertainty, vacillation, and utility could be given preliminary tests with data collected for this study, given sufficient time to develop technical details. These theoretical extensions have to do with fundamental features of the process of career development and could be checked for relatively low cost since no new data would have to be collected; hence, it would appear that the tests would be efficient use of resources. Secondly, the sample of youth for this study should be traced after leaving school and queried about their career achievements. A unique opportunity would be provided to compare the accuracy with which career expectations of high-school sophomores, juniors, and seniors foretell career achievements. The dynamic model of developing expectations could be used to forecast expectations to the timepoint of data collection after the youth leave school. These forecasts could be compared to post facto regression estimates of career attainments from career expectations of youth. Certainly, the potential returns to extending the current work appear to compensate the inevitable risks that accompany the conduct of research.

APPENDIX A

INSTRUMENTATION, DATA COLLECTION, AND CODING METHODOLOGY

Introduction

This appendix provides detailed explication of (1) instrumentation, (2) data collection procedures, and (3) data coding and correction procedures used during the three years of the study. The discussions are intended as an aid to understanding and evaluating project findings, and as a resource to other researchers involved in collecting and coding occupational data.

Instrumentation

The instruments for each year of the study are contained in six questionnaire booklets called "forms", one pair each for youth (forms 1 and 2), mother (forms 3 and 4), and father (forms 5 and 6). The first of each pair, entitled "Estimating the Chances" (forms 1, 3, and 5), contains subjective-probability measurements of youth's and parent's occupation, education, and income expectation variables. The second of each pair, "Career Aspirations" (forms 2, 4, and 6), contains conventional measurements of a range of career-development variables for youth, parents, and other significant-others. Most of the items are borrowed from existing instruments; a few (particularly the subjective probabilities) are original.

Instructions for completing the instruments are contained in the booklets. Instructions for forms 1, 3, and 5 (the subjective probabilities) are designed to be read to the respondent by the interviewer.[34] Instructions for forms 2, 4, and 6 ("Survey of Career Aspirations") are designed to be read independently by the respondent. Approximately fifteen minutes is required for completing forms 1, 3, and 5; forty minutes for forms 2, 4, and 6. Thus, each respondent spent about fifty-five minutes at each administration of the instruments.

The first and second-year instruments are reproduced in Appendix A of the interim report for year one (Hotchkiss and Chiteji 1979), and Appendix B of the report of preliminary findings for years one and two (Hotchkiss and Chiteji 1980), respectively. The third-year instruments are reproduced in Appendix B of this report. All form and page number references in the following discussions refer to the third-year instruments unless otherwise indicated.

---

[34] The term "interviewer" is used to refer to personnel who supervised completion of questionnaires in respondents' homes; all instruments, however, were self-administered.

The following discussion of instrumentation is divided into four sections. Section one discusses the subjective-probability instrument for years one through three contained in the "Estimating the Chances" booklets (forms 1, 3, and 5). Section two discusses the year-one "Career Aspirations" instruments (forms 2, 4, and 6). Item selection and development procedures, item format, and respondent reactions and response patterns are covered in these two discussions. Sections three and four discuss the revised "Career Aspirations" instruments used for years two and three, respectively. These discussions are confined to summary of those features of the revised "Career Aspirations" instruments that differentiate them from the year-one instruments.

"Estimating the Chances"--Subjective-Probability Instrument

The subjective-probability instrument was constructed specifically for this study and constitutes a unique technique permitting more sensitive measurement of uncertainty data than possible with conventional checklist methods. Four items (occupational choice, level of "regular" schooling, level of "special" schooling, and amount of expected income) comprise the instrument. These items elicit measurements for a total of six expectation variables (youth's education, occupation, and income expectations for self, and parents' education, occupation, and income expectations for their children).

Development of subjective probability instrument. Efforts during planning were directed toward perfecting the subjective-probability instrument in order to ensure its effectiveness as an alternative to conventional measurement methods. Suggestions relating to numerous elements of the instrument's design were tested during three pretests with students from a variety of racial and socioeconomic backgrounds. The following discussions summarize deliberations relative to the three elements of the design considered most crucial to its effectiveness: the format for recording subjective-probability values, the occupation checklist, and instructions to respondents.

Initially, two formats for recording respondent subjective probabilities were considered: a short line on which respondents record percentages to indicate their subjective probabilities; and a longer line (number line) representing percentage values from 0 to 100 on which respondents make checkmarks to indicate percentage values of their subjective probabilities. The decision to use number lines was based on student preference during pretests.

In perfecting the design of the number lines, project staff were faced with the issue of whether or not to label percentage points. While cognizant of the convenience that labels create for respondents and coders alike, staff were concerned that respondents would be tempted to cluster their responses at labeled points thereby destroying the continuous feature of the number lines and reducing the subjective-probability instrument to a series of discrete category items. The compromise effected was to make five short, vertical marks at the 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent points, but to label only the first and last of these marks.

Construction of a checklist of occupational titles for the subjective-probability occupation expectation question constituted another concern during the planning stage. Logic underlying probability theory dictates use of an exhaustive list; concern regarding respondent fatigue suggests use of as short a list as possible. The 1970 Census Bureau list of occupations offers important advantages. First, it purports to be comprehensive and the titles are mutually exclusive. Secondly, much descriptive information, including Duncan SEI scores, is available for these titles. The list, however, is a long one (over 400 titles) and project staff were skeptical about the validity of schemes to shorten it. Partially as a result of this dilemma, project staff tested the alternative of providing blanks for respondents to write in titles for those occupations that they are considering. Reactions to both ideas were obtained during the pretests; the result was a clear preference for the checklist. Because of the pretest outcome and the fact that the checklist reduces coding time and ensures coding accuracy, staff undertook the difficult task of collapsing census titles into a list of usable length. Titles similar both in type of work and Duncan SEI score were grouped into single categories. The result for the first-year instrument was a list of ninety-three occupational groups. In addition, space was provided at the end of the list for respondents to write in titles of jobs they felt had been omitted from the list. Prior to the second year a few of the groups were disaggregated resulting in a list of ninety-seven occupational groups; the revised list was retained for use during the third year of data collection.

Yet another concern in developing the subjective-probability instrument was how to communicate to respondents the correct way to answer subjective-probability items. Although the idea behind the subjective-probability method is an intuitively simple one, pretest observations indicated that the unusual appearance of the items is potentially confusing; numerous techniques for explaining the method were therefore considered and tested. The underlying concern was that instruction procedures might assume connotations of a test in the eyes of respondents, thereby intimidating respondents and affecting responses. Nevertheless, the staff was convinced of the need to confirm that respondents understood instructions before allowing them to complete the subjective-probability booklets. Written instructions were considered but pretests and pilot tests indicated the tendency of respondents to ignore written matter contained in the booklets. On the other hand, staff were skeptical about verbal instructions not only because of fear that some interviewers' styles might intimidate respondents, but because of concern regarding uniformity of instruction procedures across respondents. The method adopted was influenced by each of these concerns. During year-one procedures were as follows: (1) Interviewers read or paraphrased instructions based on a script contained in the front of the instrument booklets. This script provided general directions for completing all subjective probability items. (2) Respondents completed a practice example provided. (3) Interviewers examined respondents' responses to the practice example. (4) Interviewers interpreted the meaning of the response to respondents and asked if their interpretation were correct. If a respondent reported that the interpretation were inaccurate, the respondent was asked to explain the intended meaning of the response. The interviewer then instructed the respondent how the item should have been checked. (5) Respondents proceeded to each subjective probability item in the booklet and read the instructions for that item (reproductions of these instructions appear in Chapter 3). For years two and three, procedures were not as rigidly prescribed as respondents were familiar with the instrument from the previous year's experience.

Item format. Each subjective-probability item contains a list of outcomes (nine school grade levels, eight types of occupational training, ninety-three to ninety-seven job categories, or twelve income ranges) on the left side of the page and a column of horizontal lines on the right. Partial reproductions of the four items are shown in chapter 3. Each horizontal line (number line) is marked 0 percent at the left end and 100 percent at the right end. Respondents were instructed to place a checkmark on each number line to indicate what they felt their chances were of accomplishing the particular outcome listed to the left of the line.

Response patterns and revisions in the instrument. Reaction regarding the subjective-probability instrument merits special attention since this study is the first time that the instrument has been used. Although it is impossible to report figures, evidence during coding suggested that some respondents may not have understood instructions to the subjective-probability income expectation item nor the subjective-probability "regular" education item (see Appendix A, form 1, sections II and III for examples), especially during the first year of data collection. The first of these items asks youth and parents to rate, for each of the income ranges listed, the chance that the range includes the highest total yearly income that the youth will ever make. The latter requires each to rate the chance that each school level listed will be the highest level the youth will complete. For both of these items, cases were noted in which subjective-probability values for the lowest level of education or income in the lists ("high school sophomore" or "under $4,000.00") began at or near 100 percent and decreased in value as the education or income level increases. Although less than conclusive as proof of misunderstanding, such a pattern suggests that some respondents may have interpreted the questions to mean "What is the chance that you will achieve at least the level of education/income listed on the left?" On the reassuring side, however, a computer adjustment for this pattern produced negligible changes in correlations. This problem was not noted for the remaining subjective-probability items.

Staff noted other evidence of difficulties with subjective-probability instructions such as the use of circles instead of checkmarks, and the placement of more than one checkmark on a number line. However, because of and other constraints throughout the duration of the study, further experimentation and pilot testing activities necessary for resolving such difficulties were not possible; efforts to improve subjective-probability instructions were restricted to minor revisions in wording. Notwithstanding the noted problems, response rates for subjective-probability items during all three data collection periods are adequate and the high correlations achieved with the items in general (see chapter 4), indicate that these difficulties were not excessive.

Although the length of the occupation checklist was a source of concern during planning (ninety-three groups, year one and ninety-seven groups, years two and three), little negative respondent reaction to this aspect of the subjective probabilities was noted.

"Career Aspirations" Instruments--Year One

The "Career Aspirations" booklets contain several short instruments providing perceived and objective measurements of youth, peer, and parent variables. As mentioned previously, most of these constructions were borrowed from existing instruments. The first subsection summarizes procedures to locate and select these items. The second subsection describes the format of the items; the final subsection discusses respondent reactions and response patterns.

Selection of "Career Aspirations" instrument items. Selection of items was based on review of articles and reports of sixty-two previous studies on occupational and educational expectation and attainment. Through this search, staff obtained wording of item stems and response options of approximately 250 items used in operationalization of sixty career-development variables. Each item was reviewed and the best constructions were selected for inclusion in the instruments.

Item format. Most of the items in the instruments are closed-ended. The format used for the closed-ended items is the conventional one of question stem followed by a sequence of numbered response options. Respondents placed checkmarks in one or more boxes adjacent to the options, depending on whether one response (precoded questions) or more than one response (binary-code questions) were allowed.

The Occupational Aspiration Scale (OAS) comprises one series of closed-ended items used in the instruments. As explained in the text, the version of the OAS used in this study is the original version developed by Haller (Haller and Miller 1971), validated through national tests for use in measuring occupation expectations and aspirations of both male and female youths; the later version designed specifically for females was not used. The scale consists of eight lists of ten job titles each, and is designed for use by youth and parents. The youths were asked to select the job from each list that they aspire to obtain ("...if you were free to choose any of them that you wished.") or the job they expect to obtain. Similarly parents are asked to select the jobs to which they feel their child aspires or expects.

Most of the open-ended items in the instrument elicit occupation or industry information. Form 2, items 6, 7, 34, and 38; and forms 4 and 6, items 9 and 10 elicit occupation expectation and aspiration information concerning the youths and their friends. Form 2, items 45 and 46; and forms 4 and 6, items 31 and 32 elicit parents' current job information (job and industry title and description). An additional open-ended occupation question, contained in the year-one instruments only, concerns parents' past (five years previous) jobs.

The design of the open-ended occupational and industry items constitute modified versions of occupation/industry questionnaire items used by the Bureau of the Census in collecting 1970 national census data. In the first section of the items, the respondent lists a job title or name of business; in the second, the respondent provides a job or industry description.

Most of the remaining open-ended questions in the instrument elicit nonoccupational information such as ages and dates. In responding to these questions, individuals are asked to write a response, usually a number, in a space provided for this purpose.

Respondent reactions and response patterns. Response rates for all questions in the year one "Career Aspirations" instruments averaged 94 percent. There was, however, evidence that respondents had problems with some of the items.

Reaction to the OAS series was significantly negative. 84 percent of interviewers completing a post-field operation evaluation form during year one rated the OAS as the "most hostilely" greeted group of items in the questionnaires, and 38 percent called it the "most difficult to answer." Additional indication of respondent reaction to the OAS comes from comments written in questionnaire booklets. Most of these comments expressed complaints about exclusion from the lists of jobs which respondents considered appropriate for females.

Response patterns for open-ended household and family membership questions in the year-one instrument deserve mention even though response rates were not low (see page 116 for reproductions). These two items were designed to obtain numerous types of information (household and family composition, sibling order, and number and ages of siblings) using a minimum of questionnaire items, thereby conserving space and reducing respondent burden. Response patterns noted during coding, however, indicated a lack of clarity in instructions, in question design, or both. Parents often misreported the information requested, listing a household or family member's relationship to self instead of to youth. This pair of items was revised for the year-two instruments (see discussion of year-two "Career Aspirations" instrument, below). The revised items (see page 116) proved clearer to respondents.

Difficulties with open-ended youth income-expectation questions (see page 115) were also noted. Each of these questions required respondents to record two numbers representing their lowest and highest income expectations. Responses to these questions sometimes included figures entered in reverse order (i.e., the higher estimates on blanks provided for the lower estimates); figures containing misplaced commas or decimal points (e.g., $5000,00; $5000.0); and figures representing unusually low yearly income estimates, possibly the result of misplaced decimal points (e.g., Ω90.00). Such entries presented problems to coders; these items were therefore revised for the year-two instruments (for reproductions of one of these items and its year-two replacement, see discussion of year-two "Career Aspirations" instruments, below).

"Career Aspirations" Instruments--Year Two

Alterations in the year-two instruments include substitution of closed-ended (multiple choice) formats for five open-ended questionnaire items used during year one. These items measure youth's own income expectations, youth's expectations for future family income, and parental income expectations regarding youth and youth's spouse. Reasons for the substitutions were explained in the section on response patterns regarding the year-one "Career Aspirations" instruments. The design adopted is identical to that used to obtain data on current family income. Reproductions of one of these closed-ended (year-two) items (measuring youth's own income expectations), and the open-ended item (year one) that it replaces, are presented below. Formats of the other income expectation items added for year two are identical.

Year One Youth Income Expectations Question:

Assuming you work for pay after you leave home, what is the total income per year you think you will make? Please give us two estimates -- first, the lowest this figure might realistically be; and second, the highest this figure might be.

Between $________________ and $________________
(lowest) (highest)

Year-Two Youth Income Expectations Question:

Assuming you work for pay after leaving home, what is the total income per year you realistically expect to make?

For convenience, each income level is listed as a yearly, monthly, and weekly amount. The figures on each row all give the same amount per year.

INCOME RANGES

$ Per Year	Is the same as:	$ Per Month	$ Per Week
[ ] (1) Under $4,000		Under $333	Under $77
[ ] (2) 4,000 to 5,999		333 to 499	77 to 114
•			
•			
•			
[ ] (3) 40,000 or more		3,333 or more	7[illegible] or more

Other changes in the second-year instruments include revision of open-ended items reporting household and family composition. Changes in the designs of these items are shown below.

Year-One Household Composition Question
(same format is used for family composition question)

We are interested in knowing a little about your family and the people who live in your house.

Would you tell us the age of each person, including yourself, now living in your home, their sex, and relationship to [name of youth].

Age of each person living in your house	Sex of this person		Relationship to [name of youth]:
	Male	Female	
yourself: ________	____	____	____________
________	____	____	____________

Year-Two Revision (Household and Family Composition Questions)

Please list the age of each of your brothers/sisters in the space below. If you're not sure take a guess. (Include half brothers/sisters and anyone living with you who is like a brother/sister to you.)

Age of each brother/sister:

___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

Go back to the previous two questions and circle the ages of brothers and sisters who have not lived with you over the past year. If none, check here [ ].

In the first year items, parents are asked to list the name, age, sex, and relationship to the youth of all individuals in the household and in the family. (Interviewers wrote the name of the youth on the line where "[name of youth]" appears in the first-year item.) In the second (and third) year items, youth are provided with two sets of blanks on which they write in the ages of all brothers and sisters. Next, the youth circle the ages of siblings not residing in the household during the previous year.

In the effort to conserve space and reduce respondent burden, items reporting information assumed stable across measurement points (e.g., sex and race) were eliminated from the second and third-year instruments.

Respondent reactions and response patterns. Response rates for all items in the year-two "Career Aspirations" instrument averaged 96 percent. No other difficulties with instrument items were observed, not withstanding the continuing report by interviewers of respondent hostility to and difficulty with the OAS series.

"Career Aspirations" Instruments--Year Three

Modifications in the third-year "Career Aspirations" instrument include (1) the addition of items reporting youth's job history, youth's high school history, and youth's high school curriculum track as a sophomore; (2) the revision of extant items reporting youth's high school curriculum track as a senior, and current (family) and future (youth) incomes; (3) the reinsertion in the instruments of items to obtain industry information concerning parents' current jobs (this item had been eliminated in the second-year instruments); and (4) minor changes in wording in a few items.

The item recording youth's job history (form 2, item 54) utilizes a chart format to elicit the following information for all jobs held during high school: (1) job title, (2) job duties, (3) name of company worked for, (4) dates of employnment, (5) hourly pay, (6) hours worked per week, and (7) relationship of the employer to the youth. Although constructed specifically for this study, the item is similar in both design and information obtained to items used in other questionnaire and information-reporting forms.

A similar chart is used to report high school history (form 2, item 53). In this item, youth were asked to list the names and dates of attendance for each high school attended.

Although information concerning current in or out-of-school status can be inferred from the high school history question, an additional yes/no item asking whether or not youth were still enrolled in school also was inserted in the year-three "Career Aspirations" instrument (form 2, item 52).

The year-three "Career Aspirations" instruments also contain a new question concerning type of youth's school curriculum track as a sophomore (form 2, item 42), and revision of an item recording type of curriculum track as a senior (form 2, item 41). Both are closed-ended, multiple choice questions listing the following response options: "vocational," "college preparation," "general education," and "other."

Items used to obtain income data (family's current income and youth's future income) are simplified in the year-three instruments. The three-column list of response options (including figures for yearly income with monthly and weekly equivalents) contained in some of the first and all second-year multiple choice items is reduced to a single-column list containing figures for yearly income only.

The only other significant change in the third-year "Career Aspirations" instrument was the reintroduction of an item to report industry of parents' curent occupation (this item had been omitted from the second-year instruments). In the item, the name of the place of employment of parents' current job is elicited. The reason for reintroducting this item was to assist coders in assigning occupation codes to the related current occupation item.

Respondent reactions and response patterns. Response rates obtained with the year-three "Career Aspirations" items averaged 97 percent with no item obtaining lower than a 90 percent response rate.

Data Collection Procedures

The first subsection describes steps involved in planning and pilot testing data-collection procedures. The second subsection elaborates on the description of the procedures given in chapter 3; the final subsection explains methods used to monitor the field work. Differences between first, second, and third-year procedures are noted throughout.

Planning for Data Collection

The original strategy proposed for obtaining data for the study called for collecting information from high school students and their parents in Columbus, Ohio, at three time points within a three-year period. The first stage of planning involved the identification of specific procedures to implement this strategy. Toward this end, project staff sought suggestions from individuals with experience or knowledge of data-collection techniques in general and longitudinal studies in particular. In addition, staff reviewed relevant professional literature. Included in the literature review were descriptions of the data-collection operations of similar research efforts (e.g., the discussion of the methodology of the Youth in Transition Study, Bachman, 1970); and general discussions on data-collection techniques (Crider, Willits, and Bealer 1971; Dohrenwend and Dohrenwend 1968; Schulman and Converse 1971; and Taylor 1976).

In the second stage of planning, project staff discussed suggestions with a panel of consultants with expertise in the substantative area (Archibold Haller, University of Wisconsin; Evans Curry, Texas Technical University; Steven Picou, Texas A&M University; and Richard Campbell, Duke University) and with an expert in field operations methodology (John Scott, head of field division, Institute for Social Research, The University of Michigan). In the final stage, a tentative plan was developed, pilot tested, and revised, and an interviewer manual explaining procedures was developed.

Special concerns. Determination of data-collection procedures was shaped by two concerns crucial to the success of all research operations: (1) maximizing response rates (within and across measurement periods), and (2) prevention of bias. Deliberations concerning these two concerns are summarized below.

Because response rates depend initially on a subject's willingness to participate, strategies to encourage family participation were considered carefully during planning. Examples include the plan to use letters of support written to potential subjects by the superintendent of the city school system, and the provision of monetary compensation for completion of the instruments.

Because response rates are eventually dependent on the numbers of completed and returned questionnaire booklets, staff were led to consider alternatives to a mail-out system; the result was the decision to use interviewers to deliver and collect questionnaires, and to supervise completion of questionnaires in the homes.

Participation rates across measurement periods is probably the greatest challenge to planners of longitudinal studies. Because this study was designed to extend over a three-year period, staff was extremely concerned about preventing attrition. Two types of attrition were differentiated: loss of respondents due to a subject's conscious decision to withdraw, and attrition resulting indirectly from such occurrences as a subject's relocation without notification of address change. Strategies to prevent intentional withdrawal included the monetary incentives offered for each completion of the questionnaires, and attempts, in written communications to respondents, to instill in respondents a sense of the importance of the studyand of their importance to its success. Strategies to prevent the second type of attrition included use of a "follow-up form" on which the name of a contact person (who could be contacted in case of difficulty inlocating the respondent) was elicited.

Two discussions in the literature reported statistical evidence that certain segments of the population including renters and low-income individuals are prone to attrition (Wilcox 1965 and Bachman 1970). This information generated the idea of creating additional questions for the follow-up form to obtain information on whether respondents owned or rented their homes and to elicit information concerning relocation plans for the period of the research. No additional effort was required to obtain information about income status of the families because of the existence of income questions in the regular instruments. The purpose of these procedures was to permit creation of a special file of "high-risk" respondents that could be monitored more closely than other families.

The second major concern during planning related to prevention of bias. The form of bias considered the greatest threat to quality of the data is intrafamily contamination of data: i.e., the possible effects of family members on each other's responses. This includes the possibility that family members might confer with one another in filling out their questionnaire booklets and the possibility that presence of family members in the same room unconsciously influences a respondent to offer answers acceptable to the other family members (group-interview effect). Concern regarding the former (family collaboration) was one of the reasons for adopting the strategy of simultaneous completion of questionnaires under the supervision of an interviewer instead of a mail-out or drop-off system. (Drop-offs were allowed only as a last resort during years two and three in cases when schedule conflicts within a family would otherwise have meant dropping the family from the study.) Project staff found it impossible to address the concern of possible group-interview effects.

Pilot test. All data-collection procedures were pilot tested prior to the first field operation. Twenty-four respondent families and six interviewers participated in the pilot test. Procedures closely paralleled those employed during the field operations except for the method of initial contact with prospective respondents. In the field operations, letters from the Columbus Public Schools (year one, only) and the project director (all three years) were sent to respondents prior to telephone contact by interviewers; these letters were not part of the pilot test.

Following the pilot test, a debriefing session during which interviewers reported experiences was held. In addition, each interviewer submitted forms reporting on various aspects of each home visit such as: (1) ability of family members to read the instrument with understanding, (2) specific questionnaire items that created problems for respondents, and (3) duration of home visit.

Data Collection Plan

An overview of the data-collection plan is provided in chapter 3. Details concerning the plan are provided below. The first discussion provides additional details concerning selection, training and management of interviewers. The second discussion provides details concerning selection, management, and maintenance of respondents. Differences between year-one, two, and three procedures are indicated throughout.

Interviewer selection, training, and management. Twenty-eight interviewers were employed at the beginning of the firstyear data-collection operation; twenty completed the operation. During year two, the range was twenty-five to twenty. Twenty-one interviewers worked throughout the duration of the year-three operation.

Interviewers were recruited from the interviewer roster of a local survey firm, Appropriate Solutions, Inc. (ASI), and through open publicity campaigns. Most of the individuals selected had had previous interviewing experience; most interviewers who worked during the first year of the study were rehired for the second and third years.

Prior to each wave of data collection, all interviewers attended a three to four-hour briefing session covering specific information and instructions regarding the survey. Three important topics covered in the briefing sessions were: (1) underlying logic of the subjective-probability questions, (2) procedures for explaining the subjective-probability questions to respondents, and (3) techniques for obtaining codable responses to open-ended occupation and industry questions. The Special Instructions to Interviewers manual was used as the basis for discussions regarding the first two topics. Discussion regarding the third topic consisted of: (1) brief explanation of the steps and resources used in census coding, (2) presentation of coding examples to demonstrate the importance of specific and complete information, and (3) practice in coding occupational and industry entries. All three briefing sessions were conducted jointly by project staff and ASI. In addition to the briefings, interviewers had received comprehensive training on general interviewing techniques at the beginning of their employment with ASI.

Appropriate Solutions, Inc. had the responsibility for managing interviewers' work during all data-collection operations. A fieldwork office, manned by National Center staff and ASI consultants (year one) or by ASI alone (years two and three) was maintained. At this office, staff members responded to telephone calls regarding problems and questions from the field, including calls from respondents requesting changes in appointment times and dates; distributed additional supplies (e.g., questionnaire booklets) to interviewers when needed; and took turns managing interviewer check-in sessions during which interviewers reported to the office to hand in completed questionnaire booklets. During the first and second years of the study, the office was kept open during all hours that interviews were being conducted (approximatley eighty-four hours weekly). During the third year, office hours were reduced to approximately two-thirds (fifty-four hours) of the total hours of interviewing. When the office was closed, interviewers were able to leave messages on a code-a-phone machine that was answered by remote control on an hourly basis. Supervisory staff were also available to interviewers during after-hours at their home telephone numbers. Additional aspects of the year one, two, and three interviewer-management systems are summarized below.

(1) Method of assigning respondents to interviewers. Prior to the first wave of data collection, information contained in school board records (e.g., parents' names, home address, telephone number) was transferred to individual forms termed "Call Records," then grouped together according to the zip codes of the respondents' addresses. This system of geographical clustering served as the basis for distributing interview assignments to interviewers. The purpose was to minimize interviewer travel distance; it was not always possible, however, to assign interviewers to respondents in or near the former's neighborhood. During the first year, groups of new call records were distributed to interviewers as the latter completed (successfully interviewed) or resolved (definite determination that an interview was impossible) all previously distributed call records. During the second and third years, interviewers were assigned their entire quota at the beginning of the field work period, but if interviewers completed their assignment early, they were provided with additional names.

(2) Interviewer check-in system. The interviewer check-in system, in which interviewers reported to the field work office once a week to turn in completed questionnaires, enabled project staff to maintain contact with interviewers and to monitor progress of the research operation. Specific tasks accomplished during each check-in session were as follows: (1) completed questionnaire packets were returned to the field work office,

logged into entry files, and routed to the coding division; (2) the status of all nonresolved call records (neither completed or resolved) held by the interviewers was reported to project staff; (3) the numbers of completed cases, nonresolved cases, and scheduled appointments contained in each race and sex category were tallied; (4) new assignments and additional supplies were distributed to interviewers.

(3) Interviewer verification system. Work submitted by interviewers was subject to verification through telephone calls to respondents' homes. Questions asked during verification calls dealt with whether the interviews had taken place and whether all rules and procedures had been followed. During year one, all interviewers were verified at 19 percent, a total of 139 verification calls. Some irregularities in interviewer performance were discovered. (The effects of these irregularities on data quality was, however, found to be negligible.) During years two and three, experienced interviewers were verified at the rate of 10 percent, or a minimum of two interviews; new interviewers were verified at 25 percent. A total of eighty-nine verifications were conducted during the second year; no problems were identified. Eighty-two calls were made during the third year (14 percent) with no problems evidenced. In addition to investigating procedure violations, the verification telephone call also gave respondents a chance to express their thoughts about the survey to project staff. Reactions expressed were overwhelmingly positive.

Selection, management, and maintenance of respondents. The following discussion describes the selection of respondents; respondent management procedures including recordkeeping; and techniques used to maintain respondents across panels, including address checks and tracking procedures.

As reported in chapter 3, students for the survey were selected from the master list of high school sophomores attending the Columbus Public School system. The ratio of oversampling required, as reported in the text discussion of sampling (chapter 3), was three to one.

Subsequent to identifying the potential sample, parents of each student were contacted to secure permission for participation. There were three requirements for participation during year one: (1) the student had to be enrolled as a regular (nonspecial-education-program) sophomore in a Columbus public high school, (2) at least one parent (or parent substitute) had to be willing to participate, and (3) all participating family members had to be able to read and fill in their own questionnaire booklets (functional literacy). All youth participating during year one were eligible for participation during years two and three, eligibility of other family members during years two and three was dependent on the continued participation of the youth.

After letters from the superintendent of Columbus Public Schools (year one only) and the project director were mailed to respondents, interviewers made telephone calls to potential respondents in order to: (1) confirm all conditions of eligibility (it was at this point during the first year that attempts were made to eliminate special-education-program students and functional illiterates), (2) obtain agreement for participation, and (3) schedule the home visit. Home visits were always preceeded by a telephone call.

Throughout the study, staff maintained records on respondents. Two files containing respondents' names, addresses and telephone numbers were kept: one arranged alphabetically according to students' last names (with cross-reference entries for cases in which students' parents had different last names), and one arranged numerically by respondent identification number. In addition, records were kept on respondents according to zip code, and records of all respondents assigned to each interviewer. All information was kept in locked files and continually updated.

Techniques used to maintain respondents across measurement points have been mentioned in the discussion of strategies adopted by staff during planning: monetary incentives for each administration of the instruments, the attempt to instill in respondents a sense of identification with the study, and the adoption of address monitoring and tracking procedures. Additional details concerning address checks and tracking procedures are reported below.

Prior to the second and third data-collection periods, respondents were mailed a letter from the project office. This communication served two purposes: it informed respondents of the beginning of the second or third interview period, and it provided opportunity for project staff to obtain updated addresses and telephone numbers. Prior to the third year of data collection, a brief progress report of the project was also mailed to respondents. The report was general in nature (refraining from disclosure of research findings) in order to prevent contamination of future interviews. The purpose of mailing the report was to obtain an additional address check on respondents, in addition to satisfying respondents' curiosity for information about the study. The Post Office Address Correction Requested System was used to assist in obtaining new addresses.

Tracking procedures were initiated for those families who could not be contacted through either of the above mail-out efforts. The method used was to contact individuals listed on respondents' follow-up sheets. Through this method, most of the missing families were located. Of them, seven families were identified as having moved outside the interviewing area during the second year; this was true of two additional families during the third year. Packets of materials were mailed to these families. If no response was received in three weeks, certified letters were sent as a reminder. In all, five of the seven families (71 percent) who had moved out of the interviewing area prior to wave two completed and returned packets; the number during wave three was five families (56 percent).

In addition to tracking respondents who had moved, project staff reviewed all refusal or problem call records returned to the office by interviewers during the second and third years of the data collection. In many cases, a final telephone call was made from the project office to work out solutions to problems preventing the respondents' continued participation or to encourage the family to remain in the study. Of forty-five calls made during year two, nineteen resulted in completed questionnaires (42 percent), reducing the drop-out rate from a potential 15.1 percent to 12.5 percent. During the third year, approximately 80 percent of such problem families were called; approximately half of these calls resulted in completions.

Coding

The following subsections describe how the data were coded and corrected. The first subsection summarizes general characteristics of the coding operations. The second subsection focuses on coding of the subjectiveprobabilities and most other items in the instruments, explaining the planning, training, steps, and problems involved in coding these items (noncensus coding). The third subsection focuses on coding of the open-ended, occupational and industry questions contained in the instruments (census coding). Procedures adopted for coding these items constitutes a modification of procedures used by the U.S. Bureau of the Census in coding employment information collected during the 1970 dicennial census. The extensive planning, training, reference materials, and step-by-step procedures required for this operation are described. A final subsection presents the results of quality checks performed on the data during coding as well as procedures used to check and correct the keypunched data.

General Characteristics

During coding, all questionnaire responses were transformed into numeric scores and recorded on coding forms in preparation for keypunching. Standard Fortran coding forms were modified for this purpose; heavy vertical lines to identify number fields were drawn in, and all skipped columns were blackened out.

As explained earlier, completed questionnaire booklets arrived from the field in sets of six (in the case of two-parent families) or four (in the case of one-parent families). Separate forms on which interviewers recorded information concerning preinterview contacts with the family (call record forms), information concerning the interview situation (supplementary information forms), and, during years one and two, information to assist staff in locating respondents for the remaining year(s) of the study (follow-up forms) were attached. Upon arrival, each set of questionnaires was "logged in" and a disposition form attached (designed to record all internal operations performed on the data). Questionnaires were then routed to coders.

Before coding a family's questionnaires, coders "logged out" the set of booklets. This procedure consisted of listing the family identification number, the coder's initials and the check-out date in a log specially designed for this purpose.

All coding was done during regularly scheduled shifts. During year one, shifts were held over a fourteen-week period, for a total of approximately 1600 coder hours. During years two and three, coding lasted approximately nine weeks involving a total of approximately 1100 coder hours each time.

During most of year-one coding, supervision of shifts was shared between two staff members; during years two and three one staff member supervised all shifts. One of the supervisor's duties was to assist coders in coding difficult cases. Decisions made in this way were recorded in a resolution log. This system served the purpose of creating a permanent record of such decisions. Among other things, this meant that if later developments or decisions dictated a change in a coding rule, all cases coded under the original rule could be identified and changed. During the first year, use of the resolution log also enabled decisions made by the supervisor of one shift to be communicated to the supervisor of other shifts thereby contributing to consistency of procedures across coding shifts. Supervisory staff also composed and distributed weekly updates to coders clarifying procedures and informing coders of rule changes.

Cases that could not be coded by coders and/or supervisors during a coding shift were referred for later coding. The referral system relied upon forms called "referral sheets" on which the problem, the resolution, and all steps leading to the resolution were recorded. First, the coder recorded the problem on the referral sheet and inserted the sheet in the questionnaire booklet. Next, the set of questionnaires was routed to supervisors. Initially, all referred cases were read, researched and solved, if possible, by one staff member and then routinely checked by a second staff member. If the second staff member disagreed with the resolution, the case was reviewed by the project director whose decision was considered final. This plan remained in effect throughout the first half (approximately six weeks) of the first-year coding operation. During the second half of the year-one coding operation and during years two and three, however, resolution of coding problems was the responsibility of one staff member.

As is typical of coding operations, some responses failed to fit any of the predefined codes; special codes were created for such cases. Two of the special codes created for coding open-ended occupation and industry data are explained in the discussion of census coding.

Division of labor was used in the coding. Approximately half of the coders were responsible for assigning U.S. Census Bureau codes to responses to the open-ended occupational and industry questions in the instrument (census coders); half were responsible for the remainder of the instrument items (noncensus coders).

Noncensus Coding

Noncensus coding involved the coding of all open-ended items except for those designated for census coding, all closed-ended items, and the subjective probability items.

Planning. Since most questions to be coded by noncensus coders were either precoded or binary coded, little planning for coding was required. Special rulers were constructed for coding subjective-probability questions (4.25 inches long with 100 equal divisions), and rules for coding numerical responses to the nonoccupation open-ended questions were defined. For the year-two and three operations, "codebooks," consisting of questionnaires with simulated responses and instructions for coding were developed. These were used both as training and reference books throughout the year two and three coding operations.

Training. Training for noncensus coding at the beginning of each coding operation consisted of approximately an hour-and-a-half orientation to the questionnaires, the coding form, the codes, and coding procedures. Coders were taught how to measure and record values for the subjective probabilities, how to distinguish and code precoded and binary-code questions and when and how to right justify numerical entries for the open-ended questions. Much of the training consisted of practice in coding questionnaires. During training for the first-year coding operation, a set of six questionnaires completed in the field were used for this purpose. During the second and third-year training sessions, the specially-constructed "codebooks" were used.

Procedures. After "logging out" questionnaire packets, noncensus coders coded questions assigned to them in order of their occurrence.

Most of the open-ended items measured quantitative variables such as age; coding of such items involved transferring the numerical value directly to the coding form. A few of the open-ended noncensus items (such as the relationship items) required the intermediate assignment of codes.

Procedures for coding the closed-ended questions differed depending upon whether one, or more than one, response was permitted. If only one response were allowed, coders usually recorded the numerical precode used in numbering the response option. For example, to code a checkmark placed next to the fourth alternative of a sequence of response alternatives, the coder recorded a "4" on the code sheet. For those questions in which more than one response was permitted, coders recorded a 1 (checked) or 0 (not checked) on the code sheet for each response alternative, depending upon whether it had been checked or not by respondents.

Coding of the subjective-probability items required a special process. Coders used a scaled ruler, calibrated in hundreths, to measure the distances between checkmarks and the left (0 percent) end of the number line. This two-digit number was recorded on the Fortran coding form. Accuracy of measurement within two points was required.

After noncensus coders finished coding all questions assigned to them, they recorded their initials on the disposition form attached to the set of questionnaires and placed them in one of two boxes. If completely coded (containing no unresolved problems), the questionnaires were routed to census coders. If requiring referral (due to the presence of coding problems), the questionnaires were routed to the coding supervisor. Coding time for noncensus coding averaged thirty minutes for the subjective-probability items and twelve minutes for other items.

Coding problems. Few problems were noted for the noncensus coding operation, although similarity in the appearance of the precoded and binary code closed-ended items created some confusion among coders, resulting in themiscoding of some binary code items according to rules designated for the coding of precoded items. The small number of binary-code items and the low error rate (on all coding), however, reduce concern about the overall effect of this type of error.

Census Coding

Approximately six workers each year were responsible for assigning U.S. Census Bureau codes to the open-ended occupation and industry items contained in the instruments. Use of the U.S. Bureau of the Census coding system necessitated creation of a specialized operation in which occupation and industry titles provided by respondents could be looked up in Census Bureau reference books. Planning for this operation was extensive and is explained below.

Planning. In developing a system for census coding, project staff investigated coding procedures used by the Census Bureau and other research operations using census codes. The following manuals were studied: Manual for Coding Occupations and Industries into Detailed 1970 Categories and a Listing of 1970-Basic Duncan Socioeconomic and NORC Prestige Scores (Featherman, Sobel, and Dickens 1975); Social Factors in Aspirations and Achievements Occupation-Industry Coding Handbook (Sheehy, Netkin, and Grant 1974); Occupation and Industry Coding Manual of the Minnesota Labor Force Study (Gustafson 1977); and the introductory sections of the Alphabetical Index of Industries and Occupations (Alphabetical Index) and Classified Index of Industries and Occupations (Classified Index) (U.S. Bureau of the Census 1971). In addition, project staff gathered suggestions from consultants and other individuals with experience in similar coding operations.

From these investigations, numerous ideas for coding occupations and industries were considered. In one study (Sheehy, Netkin, and Grant 1974), census coders were subdivided into three groups coding current job information, job expectations, and problem cases, respectively. In addition, a system of independent coding of each occupation and industry questionnaire item was used. The expressed aim of this system was to avoid interquestion bias--the tendency of coders to select a census code for one questionnaire item because of knowledge concerning the coding of other questionnaire items. Implementation of this system meant that census coders were restricted to coding only one employment-related item per questionnaire at any given time; to accomplish this objective, questionnaires were rotated among census coders. Shelf space was allotted and labeled for each occupation and industry question. All incoming questionnaires were placed in the first slot on the shelf, i.e., that slot reserved for the first job or industry question contained in the questionnaire. A census coder coded the first entry in a questionnaire and then placed the questionnaire in the next slot. Another census coder then coded the second entry. This process continued until all occupation and industry questions in each questionnaire were coded. This system was not adopted for the present study due to the excessive space, time, and supervisory efforts necessitated; however, census coders were instructed not to allow previous coding decisions to influence their coding of any particular item.

The Minnesota Labor Force Survey employed a system of industry coding based on a listing of all major companies located in the study area (Gustafson 1977). Names of firms contained in the listing were arranged according to the Standard Industrial Classification coding system developed by the U.S. Government Office of Management and Budget. Although these codes differ from the census codes, it is possible to cross-reference these codes to census codes by using the introduction section of the Alphabetical Index of Industries and Occupations. Coders could, therefore, use the listing to locate industry codes for names of firms contained in the questionnaires. Although these procedures differ from Census Bureau methods, and have some disadvantages (see Sheehy, Netkin, and Grant 1974), they possess the important advantage of being easier and more direct, involving less coder interpretation and judgment than the Census Bureau method.

A system analogous to the Minnesota technique was adopted for the year-one and three operations (industry was not coded during time two). A listing of firm names and codes for the study was obtained in the form of a membership list for the Columbus Area Chamber of Commerce. This list contains the names and Standard Industrial Codes (SIC) for approximately one-third of all firms located in Columbus, Ohio. Although the list is not a complete one, project staff felt that the ease and uniformity introduced by use of the list would effect greater validity of the coded data. Comparison of codes assigned during a trial period at the beginning of the year-one operation using the Census Bureau system (in which interpretation and judgment were necessary), and codes assigned using this system support this contention.

A problem considered during the planning operation was whether to code the industry of the respondent's specific job or the industry of the respondent's employer. For example, which industry category and code should be used for an auto mechanic employed by Sears Department Store? Although opinion in the literature regarding this issue varied (see Sheehy, Netkin, and Grant 1974), the plan adopted for this study was to use the category and code reflecting the major activity of the firm. One reason for this decision was that it permitted use of the Columbus Chamber of Commerce membership roster for all industry coding. Also, coding the firm rather than the job creates less overlap with occupation codes.

As a result of preliminary reading concerning experiences of other coding operations, project staff anticipated that some respondent entries would be too general or vague for assignment of a single code. A specialized system to handle this problem was reported in the literature (Sheehy, Netkin, and Grant 1974). Table 8 in the 1970 Census of Population Occupation by Industry (U.S. Bureau of the Census 1972) was used to obtain statistics concerning the number of individuals of each sex working in various occupations. All occupational groups suggested by a respondent's vague entry were looked up in this table. The occupational group containing the greatest number of individuals of the same sex as the respondent was then chosen as the most likely job category for the vague entry. This system was not used in the current study, however. Instead, all possible codes for the vague entry were listed on a special form called a Multiple Code Sheet. The most appropriate of the codes was listed as the first entry (in addition to being listed on the coding sheet) with other codes following. The plan for utilizing multiple codes during analysis was to average Duncan SEI codes for all the occupational codes listed on the Multiple Code Sheet. No use of this data is included in this report, however.

During planning, staff experimented with various ways to use the Census Bureau's Alphabetical Index and Classified Index. Each of these sources contains two types of listings for both industry and occupational titles. The Industrial Classification System (three pages) and the Occupational Classification System (five pages) comprise one type of listing, summarizing all numerical codes and their title headings. Throughout the remainder of this discussion, these summary lists are referred to as the short list of industries and the short list of occupations, respectively. In addition to the short lists, the Alphabetical and Classified Indexes provide a breakdown of each of the code groups, listing all job or industry titles contained in each group, in either alphabetical order (Alpha Index) or numerical order by code group (Classified Index). These are referred to as the long lists.

Initially, a plan to use the short lists as the primary coding reference in census coding was adopted. This was done under the assumption that coding of the local sample data would be less complicated than the U.S. census operation due to the limited geographical area of the respondents, and to restrictions imposed by the relatively simpler design of the questionnaire items used to elicit employment information. The decision also was due, in part, to difficulties in obtaining details regarding specific procedures employed by the Census Bureau, and to project staff's initial lack of appreciation of the complexities of occupational coding.

Routine quality checks performed on the coded data after the first three weeks of year-one coding, however, revealed difficulties with the simplified system. As a result, procedures were revised, and all previously-coded occupation and industry entries were recoded. The revised procedures relied on the census's long lists as the reference source for all census coding. (See procedures section for a complete explanation of this system.)

Training. Training of census coders during the year-one operation consisted of a three-hour training session followed by a three-week period of close supervision checks on coders' work. During years two and three, training for census coding consisted of six one-and-one-half hour training sessions. Each session was divided between discussion of procedures and practice in coding. Training exercises designed by the Census Bureau and examples of responses from completed questionnaires from the present study were used for the practice sessions.

Coding references. Both Census Bureau references were used in census coding: the Alphabetical Index of Industries and Occupations and the Classified Index of Industries and Occupations. Other principal reference sources were the Dictionary of Occupational Titles (D.O.T.) for occupational coding, and the 1977-78 Columbus Chamber of Commerce Membership Roster and Directory for industry coding. A description of the content and format of each of these volumes is provided below. Procedures for census coding are then explained.

The Alphabetical Index of Industries and Occupations lists industrial and occupational titles reported in national censuses and surveys conducted by the U.S. Bureau of the Census. In addition to the eight-page summary of title headings of all industrial and occupational codes (short lists), the text is divided into two sections: the first comprises a listing of industrial titles; the second, a listing of occupational titles. In each of these sections, titles are listed in alphabetical order on the left side of the page and three-digit codes for each are printed on the right-hand side. In some cases, industrial codes (called industry restrictions) appear in the middle. For a complete description of the text the reader is referred to the introduction section of the Alphabetical Index.

The Classified Index of Industries and Occupations is identical to the Alphabetical Index in its contents; differences between the two volumes are organizational only: in this volume, job and industry titles are listed by code category, and all code categories are listed in numerical order by code number.

The 1977-78 Columbus Area Chamber of Commerce Membership Roster and Directory includes a forty-five page alphabetical list of the approximately 2,300 businesses belonging to the Columbus Area Chamber of Commerce. For each firm, a code indicating the firm's classification according to the Standard Industrial Classification (SIC) system is given. Coders cross referenced these SIC codes by consulting the short lists contained in the Alphabetical and Classified Indexes in which both SIC and census codes are listed.

The Dictionary of Occupational Titles (D.O.T.) is published by the U.S. Manpower Administration and contains 35,550 job titles. For each job title, the D.O.T. either describes the job or refers the reader to another (synonymous) title containing a description. The order of job titles is by code group, but the D.O.T. coding system is specific to the Office of Manpower Administration and differs from the U.S. Census Bureau Coding System. Project staff were unable to locate a cross-reference source in time for the first-year coding operation; two partial cross references were located and used in the year-two and three coding operations (National Occupational Information Coordinating Committee 1979; U.S. Department of Labor 1975).

Procedures for coding occupations. As stated in the text, the plan eventually adopted for coding the open-ended occupation and industry items constitutes a modified version of procedures used by the U.S. Census Bureau. [For description of exact procedures used by the Census Bureau, the reader is referred to the 1977 Census of Oakland, California Industry and Occupation Coding Training Manual (U.S. Bureau of the Census 1977).]

After "logging out" a questionnaire packet, the coder's first step in coding occupation was to decide if the job title provided by the respondent in the first section of the question was consistent with the description of duties listed in the second section (see form 2, item 45 for example of open-ended occupation question); this step required the coder's judgment. If convinced that the job title constituted an accurate representation of duties performed, the coder looked the job title up in the Alphabetical Index (long list). If an industry restriction appeared between the title and code (see explanation of Alphabetical Index), it was necessary for the coder to make sure that the industry code for the occupational entry being coded was consistent with those listed in the industry restriction. The final step in coding was to record the three-digit code for the job title on the coding form. The most common situations complicating these procedures in order of the frequency of their occurrence were: (1) inability to locate the exact wording used by the respondent in the Alphabetical Index, (2) suspected inconsistency between the job title and description, and (3) omission of a job title in the questionnaire response. Additional procedures were required in each of these cases and are explained below.

If the exact terms or order of words used in a respondent's job title could not be found in the Alphabetical Index, the coder looked up other wordings (e.g., "teacher's assistant" instead of "teacher's aid"), or other possible word orders (e.g., "clerk, coding" instead of "coding clerk"). Coders used their own ingenuity, the job description section of the question, the D.O.T., The Encyclopedia, or other sources in generating such alternatives.

Whenever a coder suspected that the job title listed might be inaccurate as a description of duties performed, the D.O.T. or The Encyclopedia of Careers and Vocational Guidance (Hopke 1977) was consulted. The job title in question was looked up and the description of duties for the title contained in the reference book was compared to the description of duties contained in the questionnaire. If inconsistency were determined, coders ignored the title and relied on the description of duties provided in the questionnaire to determine an appropriate code. This policy was consistent with policy used in a previous study (Sheehy, Netkin, and Grant 1974) and reflects agreement with the argument that job descriptions are usually more reliable than job titles (reasons include inflation of job titles by employers). (For the same reasons, coders were instructed to place more weight on the job description in other cases of ambiguity, as well.) Whenever there was complete contradiction between a job title and description, a special code was used (see section on Special Codes).

In cases in which the job title section of the question had not been answered, the coder had to rely on the description of duties provided in the question. In such cases, the coder was required to determine an appropriate job title based on information provided in the description. The coder then proceeded with the other steps in coding.

After locating the code in the Alphabetical Index, it was sometimes judged advisable to double check the code in order to obtain further evidence of the appropriateness of the code in representing the respondent's occupation. The short list of occupations and the Classified Index were used for this purpose. For example, in doublechecking the code 666 for "baker," a coder would find that this code denotes jobs falling under the heading of "Stationary firemen," and would therefore be led to reject 666 in coding bakers of food items.

Whenever a respondent's occupation entry was too ambiguous for assignment of a single code, the usual procedure was to list all possible codes on a special form called the Multiple Code Sheet. The code judged to be the best fit for the entry was listed first and was the only code recorded on the coding form. The rationale for this procedure and the uses suggested for the additional data for the analysis stage have been mentioned in the planning for census coding section. If the entry were judged too general for use of the Multiple Code Sheet, a special code was sometimes used (see section on Special Codes below).

Procedures for coding industry (years one and three). The year-one and three instruments contain two questions eliciting industry information about parents' current and past jobs. Due to the fact that it was often necessary to know the industry code of a job before an occupational code could be assigned, these questions were coded before occupation questions. In the case of multipurpose places of business (cutting across two or more industries), the major industry of the firm was coded. This was done even if the assigned code disagreed with the specific industy of the respondent's job. For example, a hairdresser working at Sears Department Store was assigned the industry code for department stores instead of hairdressing services. The rationale for this policy has been explained in the planning for census coding section.

As explained in the discussion of planning, procedures adopted for coding industry in this study differed from Census Bureau procedures. Exact steps were as follows: (1) the name of the respondents' place of employment was obtained from the questionnaire item. (2) This name was looked up in the *1977-78 Columbus Chamber of Commerce Membership Roster and Directory* in order to obtain a *Standard Industrial Classification (SIC)* code. (3) The short list of the *Alphabetical Index* was used as a code cross reference in order to obtain an equivalent census industry code for the SIC code. (4) This census code was recorded on the coding form.

For cases in which the employer's name was not found in the Chamber of Commerce Roster, the company name was looked up in the *Directory of Ohio Manufacturers* (Ohio Department of Economic and Community Development 1975), which provides SIC codes for major firms in the state of Ohio. If this attempt proved unsuccessful or if the name of business had been omitted on the questionnaire, coders resorted to routine census procedures for coding industry: the industry description was read and interpreted by coders and an industrial title was looked up in the industry section (long list) of the *Alphabetical Index*. If located, the three-digit code indicated in the text was recorded; if the exact title could not be located, synonymous titles or alternative word orders were checked.

If the description was missing from the questionnaire or was inadequate, a street directory (Polk 1977) was consulted, or a telephone call was made to the business division of the local public library or the Corporation Registration/Licensing Office of the Ohio Department of State. All of these sources provide at least a brief description of firms and companies when the company name is known or, in the case of the State Corporation Registration Office, if the company is incorporated. If these measures failed, the firm was telephoned and asked to supply the needed information.

For both occupational and industrial coding, two additional resources developed during the coding operations proved useful. These were: (1) file boxes containing resolutions of problem cases encountered in two previous studies, and (2) the referral sheet notebook containing a record of resolutions of problems encountered in the current study. Coders could consult either or both of these two resources at any point in the coding operation.

Whenever census coders were unable to code entries quickly, they requested supervisory help. As in the case of noncensus coding, resolutions reached through this procedure were always recorded in the Resolution Log for later review.

Special codes. Procedures used in the census coding operation included use of special codes designated for the coding of unanticipated responses. Project staff either invented these codes or redefined already existing Census Bureau codes for use in such cases. The main reason for special codes was to preserve as much information as possible, even if the information were somewhat vague or incomplete. Two of the special codes are particularly interesting and, therefore, are described below.

(1) Census industry codes and census occupation allocation codes. Whenever possible, either Census Bureau industry codes or census occupation allocation codes were redefined for usage in coding those occupational entries too vague for the assignment of either single or multiple occupation codes. For example, when a respondent provided the nonspecific response of "works in a department store," the Census Bureau industry code, 609, for department store was assigned (instead of attempting to list all possible occupation codes relevant to "department store" on a multiple code sheet, or using the missing data code) thereby preserving this item of nonspecific information. When a respondent listed "professional job," the Census Bureau occupation allocation code, 196, for "professional technical, and kindred workers" was used. Both of these procedures were employed only as a last resort due to the fact that both Census Bureau allocation codes and industry codes lack Duncan SEI equivalents.

(2) Code for contradictory responses. Previous discussion has explained procedures for coding cases involving partial contradiction between job titles and job description (see section on census coding procedures). For cases in which there was complete contradiction, a special code was invented. Coders were instructed to list this code on the coding form;, the same code was listed on a multiple code sheet followed by appropriate codes to represent both the job title and the job description.

Quality Checks and Correction of the Data

During the year-one coding operation, a special quality check across all coders was completed approximately three weeks after the start of the coding operation. At least one-third of each coder's work was checked on all nonoccupational questions at this time. At a later point, a check of coding on all occupation and industry questions was completed. As a result of these two checks, some changes in the year-one coding operation were made (as summarized in the discussion of planning). Throughout the remainder of the year-one operation and during the year-two and three coding operations, manual quality checks on 10 percent of the census and noncensus coding were conducted. Coder error rates (per variable) based on these manual checks during the three coding operations remained fairly constant, averaging 1 percent (method of calculation = division of number of errors by number of variables, multiplied by number of respondents, and adjusted for missing parent cases by multiplication of total by 2.5/3).

As mentioned in chapter 3, a computer check was completed after the data were keypunched. 100 percent of the cases were checked on each variable for numerical values outside the valid range for the variable and approximately 10 percent of the cases were checked on all columns for all types of coding and keypunching errors. Error rates (per variable per respondent) based on the 10 percent computer check for years one, two, and three, were .55 percent, .53 percent, and .14 percent, respectively. The substantial decline in error rate is attributed to improvements in both the keypunching and the coding operations over the three years.

APPENDIX B

WAVE-THREE QUESTIONNAIRES

Introduction

This appendix reproduces the questionnaires used during data collection for wave-three. These questionnaires are very similar to those used for wave-one and wave-two. Most questions in wave-three were taken verbatim from the previous questionnaires. A copy of the wave-one questionnaires can be found in Hotchkiss and Chiteji (1979), and a copy of the wave-two questionnaires can be found in Hotchkiss and Chiteji (1980).

One pair of questionnaires was completed by each respondent. Form number by type of respondent is shown below:

Form 1--Estimating the Chances: Youth's Form (completed by youth)

Form 2--Survey of Youth, Part II: Career Aspirations

Form 3/5--Estimating the Chances: Parents' Form (form three completed by mothers; form five completed by fathers)

Form 4/6--Survey of Mothers: Career Aspirations (form four completed by mothers; form six completed by fathers)

Form three is identical to form five, and form four is nearly identical to form six; hence only one reproduction of these pairs in included.

This survey continues the research on career aspirations in which you have participated twice already. The initial two phases of the study have been very successful, due in large part to your cooperation. To accomplish our major goal of studying changes in career aspirations, however, your continued participation is critical. We thank you for agreeing to this third home visit.

Please recall that when these questionnaires leave your home, no one will be allowed to see how you answered any question -- your answers are strictly confidential. DO NOT put your name on any questionnaire.

Again, thank you for helping us.

Protocol No. 78B 191
Form 1
Interview 3

OSU
The Ohio State University

THE NATIONAL CENTER
FOR RESEARCH IN VOCATIONAL EDUCATION

1960 Kenny Road
Columbus, Ohio 43210

Phone: 614–486-3655
Cable: CTVOCEDOSU/Columbus, Ohio

ESTIMATING THE CHANCES

YOUTH'S FORM

Form 1

This survey continues the research on career aspirations in which you have participated twice already. The initial two phases of the study have been very successful, due in large part to your cooperation. To accomplish our major goal of studying changes in career aspirations, however, your continued participation is critical. We thank you for agreeing to this third home visit.

Please recall that when these questionnaires leave your home, no one will be allowed to see how you answered any question -- your answers are strictly confidential. DO NOT put your name on any questionnaire.

Again, thank you for helping us.

Form 1

We recognize that it is hard for you to be sure about your future career. In this questionnaire, therefore, we ask you to estimate the chance that you will obtain different occupational, educational and income options. Of course, you may not be sure about the chances either, but please give us your best guess for every question.

OCCUPATIONS

1. The next few pages contain a list of jobs with a line to the right of each job. We want you to use the line to guess the chance that each job will be your main job for most of your life.

   Look at some of the questions to see how they are laid out, then read the directions below:

   a. Put one check on each line

   b. Place the check so that the farther to the right it is, the higher the chance that this occupation will be your main job

   c. Don't worry if most of your checks are near zero, this is normal

NAME OF JOB	CHANCE YOU WILL BE IN THIS JOB (Place one check on each line)
Military officer [1:08]	0 ——————————————— 100
Military enlisted person, not an officer [1:11]	0 ——————————————— 100

NOTE: The remaining are civilian jobs only.

Accountant [1:14]	0 ——————————————— 100
Architect [1:17]	0 ——————————————— 100
Computer specialist (such as programmer) [1:20]	0 ——————————————— 100

Form 1

NAME OF JOB	CHANCE YOU WILL BE IN THIS JOB (Place one check on each line)
Forester or conservationist [1:23]	0 ____ ____ ____ ____ 10
Judge [1:26]	0 ____ ____ ____ ____ 10
Librarian or curator [1:29]	0 ____ ____ ____ ____ 10
Physical scientist such as geologist or astronomer, but not an engineer, or a college professor [1:32]	0 ____ ____ ____ ____ 10
Engineer such as chemical engineer or electrical engineer, but not a college professor [1:35]	0 ____ ____ ____ ____ 10
Social scientist, such as psychologist, economist, or sociologist, but not a college professor [1:38]	0 ____ ____ ____ ____ 10
Biological or agricultural scientist, but not a college professor [1:41]	0 ____ ____ ____ ____ 10
Lawyer (but not a college professor) [1:44]	0 ____ ____ ____ ____ 10
Physical, speech, or occupational therapist [1:47]	0 ____ ____ ____ ____ 10

Form 1

NAME OF JOB	CHANCE YOU WILL BE IN THIS JOB (Place one check on each line)
Airplane pilot [1:50]	0 100
Air traffic controller or radio operator [1:53]	0 100
Flight engineer [1:56]	0 100
Designer, including designer of clothes, pottery, rugs, interior decorating, glassware [1:59]	0 100
Bank officer or financial manager [1:62]	0 100
Funeral director or embalmer [1:65]	0 100
Inspector such as building safety inspector or bank examiner [1:68]	0 100
Writer or author (fiction or nonfiction), journalist, reporter, editor, public relations person or publicity writer [1:71]	0 100
Postmaster or mail superintendent, sales manager, or health administrator [1:74]	0 100

Form 1

NAME OF JOB	CHANCE YOU WILL BE IN THIS JOB (Place one check on each line)
Railroad conductor, officer, or pilot of a ship, building manager or superintendent [1:77]	0 100
Storekeeper or restaurant, cafeteria, or bar manager *[2:08]	0 100
Corporation executive or college administrator such as college dean [2:11]	0 100
Receptionist or office machine operator such as computer, keypunch or telephone operator [2:14]	0 100
Clerical work such as file clerk, postal clerk, or stock clerk [2:17]	0 100
Blacksmith or boilermaker [2:20]	0 100
Operator of earth moving machinery and other heavy machinery such as bulldozer, grader, or crane [2:23]	0 100
Carpentry work such as cabinet maker or housebuilder [2:26]	0 100

Form 1

NAME OF JOB	CHANCE YOU WILL BE IN THIS JOB (Place one check on each line)
Bookbinder or typesetter in a print shop or related work [2:29]	0 100
Jeweler, watchmaker, machinist, optician, grinder, or polisher [2:32]	0 100
Tailor or upholsterer [2:35]	0 100
Tool and die maker [2:38]	0 100
Garage worker or gas station attendant [2:41]	0 100
Meatcutter, butcher, baker, or related work [2:44]	0 100
Operator of a precision machine such as lathe, drillpress, milling machine, or grinder [2:47]	0 100
Textile worker such as weaver [2:50]	0 100
High school or grade school administrator such as principal or superintendent [2:53]	0 100
Other administrator or manager such as union officer, office manager [2:56]	0 100
Labor negotiator (but not a union officer) [2:59]	0 100

Form 1

NAME OF JOB	CHANCE YOU WILL BE IN THIS JOB (Place one check on each line)
Bank teller, cashier in a store, or bookkeeper [2:62]	0 ____ 100
Vehicle dispatcher, such as taxicabs or police cars [2:65]	0 ____ 100
Insurance adjuster, examiner, or investigator [2:68]	0 ____ 100
Mail carrier, deliveryman, routeman or reader of gas or electric meters [2:71]	0 ____ 100
Auctioneer [2:74]	0 ____ 100
Insurance agent or underwriter [2:77]	0 ____ 100
Real estate agent or appraiser *[3:08]	0 ____ 100
Stock and bond salesman [3:11]	0 ____ 100
Sales clerk in a store or other salesperson [3:14]	0 ____ 100
Medical secretary [3:17]	0 ____ 100
Secretary or stenographer (except medical secretary) [3:20]	0 ____ 100

Form 1

NAME OF JOB	CHANCE YOU WILL BE IN THIS JOB (Place one check on each line)
Railroad brakeman or railroad switchman [3:23]	0 ________________ 100
Garbage collector [3:26]	0 ________________ 100
Longshoreman, stevedore, sailor, or deckhand [3:29]	0 ________________ 100
Lumberman or related work such as working in a sawmill or miner, such as coal miner or other mine work [3:32]	0 ________________ 100
Operator of a machine such as riviter, photo developer, welder or other type of worker [3:35]	0 ________________ 100
Farmer or farm manager, farm foreman [3:38]	0 ________________ 100
Farm laborer or self-employed farm service worker such as sheep shearer or combine operator [3:41]	0 ________________ 100
Cleaning service worker in a business such as a hotel but not a private home -- such as janitor, cleaning woman, maid [3:44]	0 ________________ 100
Office messenger, telegraph messenger, newsboy or newsgirl, or peddler [3:47]	0 ________________ 100

Form 1

NAME OF JOB	CHANCE YOU WILL BE IN THIS JOB (Place one check on each line)
Food service worker such as bartender, busboy in a hotel, dishwasher, food counter or fountain worker or waiter or waitress [3:50]	0 100
Protective service worker such as fireman, policeman, detective, sheriff, or bailiff [3:53]	0 100
Worker in a family home -- such as cook, child care worker, housekeeper, maid, or butler [3:56]	0 100
Personal service worker such as airline stewardess baggage porter or bellhop, barber, boarding and lodging housekeeper, elevator operator, hairdresser or cosmetologist, usher [3:59]	0 100
Medical doctor or dentist [3:62]	0 100
Registered nurse or dietitian [3:65]	0 100
Optometrist (eye doctor) [3:68]	0 100
Pharmicist or druggist [3:71]	0 100
Veterinarian [3:74]	0 100

Form 1

NAME OF JOB	CHANCE YOU WILL BE IN THIS JOB (Place one check on each line)
Technical work related to health care, such as radiologic assistant, dental hygienist, therapy assistant, or laboratory technician [3:77]	0 ________ 100
Chiropractor, podiatrist (foot doctor) *[4:08]	0 ________ 100
Minister, priest, or rabbi (or other clergyman) [4:11]	0 ________ 100
Other religious worker [4:14]	0 ________ 100
Social worker or recreation worker [4:17]	0 ________ 100
Elementary school teacher (including Kindergarten and preschool) [4:20]	0 ________ 100
High school teacher, vocational or educational counselor [4:23]	0 ________ 100
Teacher aide [4:26]	0 ________ 100
Other type of teacher [4:29]	0 ________ 100
Science technician, surveyor, or draftsman [4:32]	0 ________ 100

Form 1

NAME OF JOB	CHANCE YOU WILL BE IN THIS JOB (Place one check on each line)
Health service worker with no college training such as practical nurse, medical technician, or dental assistant [4:35]	0 ____ 100
Locomotive engineer or fireman [4:38]	0 ____ 100
Auto mechanic or repairman of heavy equipment [4:41]	0 ____ 100
Household appliance, radio, television, or other mechanic or repairman [4:44]	0 ____ 100
Motion picture projectionist [4:47]	0 ____ 100
House painter or plasterer [4:50]	0 ____ 100
Piano or organ tuner or repairman [4:53]	0 ____ 100
Brick layer, electrician, plumber or related work [4:56]	0 ____ 100
Sheetmetal worker or tinsmith [4:59]	0 ____ 100
Shoe repairman or shoemaking machine operator [4:62]	0 ____ 100

Form 1

NAME OF JOB	CHANCE YOU WILL BE IN THIS JOB (Place one check on each line)
Sign painter or letterer [4:65]	0 |____|____|____|____| 100
College teacher or professor of sciences such as: physics, chemistry, astronomy, mathematics, geology, biology, agriculture, medicine, dentistry, pharmacy, or veterinary medicine [4:68]	0 |____|____|____|____| 100
College teacher or professor of nonsciences such as: psychology, economics, sociology, political science, law, history, English, language, education, business, commerce, industrial arts, sport coach or physical education, art, drama, music [4:71]	0 |____|____|____|____| 100
Entertainer or artist such as actor, dancer, musician, composer, painter, sculptor, photographer, radio or TV announcer, professional athlete [4:74]	0 |____|____|____|____| 100
Skilled or semiskilled craftsman, such as carpet installer, wallpaper hanger, foreman, telephone installer, repairman or lineman [4:77]	0 |____|____|____|____| 100

Form 1

NAME OF JOB	CHANCE YOU WILL BE IN THIS JOB (Place one check on each line)
Transport equipment operator such as parking attendant, bus driver, conductor or motorman on mass rail transport, taxicab driver, chauffer, or truck driver *[5:08]	0 100

Form 1

SECTION II

INCOME

2. Please rate the chance that each of the boxes below includes the HIGHEST total yearly income (not just take-home pay) you will ever make.

Assume the value of the dollar doesn't change.

Use the same method you did for jobs.

a. Put one check on each line

b. Place the check so that the farther to the right it is, the higher your chance that this will be the most you will ever make

c. Since only one income range can include the highest income you will ever make, if you check very high on one, the rest necessarily must be low

IF YOU HAVE ANY QUESTIONS, PLEASE ASK

$ PER YEAR	CHANCE THIS IS THE HIGHEST INCOME YOU WILL EVER MAKE (Place one check on each line)	
Under $4,000	0 ____________ 100	[5:11]
4,000 - 5,999	0 ____________ 100	[5:14]
6,000 - 7,999	0 ____________ 100	[5:17]
8,000 - 9,999	0 ____________ 100	[5:20]
10,000 - 11,999	0 ____________ 100	[5:23]
12,000 - 14,999	0 ____________ 100	[5:26]
15,000 - 19,999	0 ____________ 100	[5:29]
20,000 - 24,999	0 ____________ 100	[5:32]
25,000 - 29,999	0 ____________ 100	[5:35]
30,000 - 34,999	0 ____________ 100	[5:38]
35,000 - 39,999	0 ____________ 100	[5:41]
40,000 - or more	0 ____________ 100	[5:44]

Section III

EDUCATION

3. Please rate the chance that you will leave school for good after completing each level listed below.

   Use the same method you used for jobs and income.

   a. Place one check on each line

   b. Place the check so that the farther to the right it is, the higher you think your chance that this is the most education you will get

   c. Since only one grade can be the highest you will ever attend, if you check very high on one, the rest must necessarily be low

REGULAR SCHOOL LEVEL	CHANCE THIS WILL BE THE MOST SCHOOLING COMPLETED (Place one check on each line)	
High school sophomore	0 ——————————— 100	[5:47]
High school junior	0 ——————————— 100	[5:50]
High school senior	0 ——————————— 100	[5:53]
College freshman	0 ——————————— 100	[5:56]
College sophomore	0 ——————————— 100	[5:59]
College junior	0 ——————————— 100	[5:62]
College senior	0 ——————————— 100	[5:65]
Master's degree	0 ——————————— 100	[5:68]
Ph.D. or professional degree	0 ——————————— 100	[5:71]

4. Different types of special training are listed below next to measuring lines. Please rate the chance that you will complete each one.

   a. Place one check on each line

   b. Place the check so that the farther to the right it is, the higher you think your chance is

   c. Since it is possible to complete more than one kind of special educational training, you can have more than one high check

IF YOU HAVE ANY QUESTIONS, PLEASE ASK

TYPE OF SPECIAL SCHOOLING	CHANCE OF COMPLETION (Place one check on each line)	
Nursing school (for RN's only)	0 ____________________ 100	*[6:08]
Trade or craft such as mechanic, electrician, beautician, etc.	0 ____________________ 100	[6:11]
Business or office work	0 ____________________ 100	[6:14]
Science or engineering technology such as draftsman	0 ____________________ 100	[6:17]
Agricultural school	0 ____________________ 100	[6:20]
Home economics school	0 ____________________ 100	[6:23]
Real estate	0 ____________________ 100	[6:26]
Other, please specify ____________ ____________	0 ____________________ 100	[6:29]

Protocol No. 78B 191
Form 2
Interview 3

OSU
The Ohio State University

THE NATIONAL CENTER
FOR RESEARCH IN VOCATIONAL EDUCATION

1960 Kenny Road
Columbus, Ohio 43210

Phone: 614—486-3655
Cable: CTVOCEDOSU/Columbus, Ohio

SURVEY OF YOUTH
CAREER ASPIRATIONS

Form 2

SECTION I

QUESTIONS ABOUT YOUR FUTURE CAREER

The questions in this section are about your hopes and expectations for your future career. Please answer every question to the best of your ability, even if you aren't sure or currently aren't in school.

1. Do you want to go to college? (Please check one.) [1:08]

   ☐ 1. Yes, very much
   ☐ 2. Yes, somewhat
   ☐ 3. Not sure
   ☐ 4. No, prefer not to go
   ☐ 5. No, definitely not

2. What is the highest level of regular school you want to finish? (Please check one.) [1:09-10]

   Level of Regular School

   ☐ 10. High school sophomore
   ☐ 11. High school junior
   ☐ 12. High school graduate
   ☐ 13. College freshman
   ☐ 14. College sophomore
   ☐ 15. College junior
   ☐ 16. College graduate (Bachelor's degree)
   ☐ 17. Master's degree
   ☐ 18. Ph.D. or professional degree such as medicine, law, or dentistry

3. Disregarding what you want, what is the highest level of school you realistically think you will finish? (Please check one.)

[1:11-12]

Level of Regular School

☐ 10. High school sophomore
☐ 11. High school junior
☐ 12. High school graduate
☐ 13. College freshman
☐ 14. College sophomore
☐ 15. College junior
☐ 16. College graduate (Bachelor's degree)
☐ 17. Master's degree
☐ 18. Ph.D. or professional degree such as medicine, law, or dentistry

Form 2

If you are sure you will not go to college, skip to question 5.

4. What subject do you think you most likely will study for your highest level of regular schooling? (Please check one.)

[1:13-14]

Note: If you expect two or more majors or aren't sure, place a number in the bracket beside your choices. Use a one (1) to indicate most likely choice or most important subject, a two (2) to indicate second choice, etc.

[ ] 1. Business and administration
[ ] 2. Agriculture
[ ] 3. Home economics
[ ] 4. Art (painting, sculpture, theater)
[ ] 5. Music
[ ] 6. Biology
[ ] 7. Black studies
[ ] 8. English
[ ] 9. Foreign language
[ ] 10. History
[ ] 11. Philosophy
[ ] 12. Astronomy
[ ] 13. Chemistry
[ ] 14. Mathematics
[ ] 15. Physics
[ ] 16. Statistics
[ ] 17. Anthropology
[ ] 18. Economics
[ ] 19. Political science
[ ] 20. Psychology
[ ] 21. Sociology
[ ] 22. Journalism
[ ] 23. Engineering
[ ] 24. Architecture
[ ] 25. Law
[ ] 26. Medicine
[ ] 27. Dentistry
[ ] 28. Veterinary medicine
[ ] 29. Seminary (preachers, priests, rabbis)
[ ] 30. Pharmacy
[ ] 31. Social work
[ ] 32. Elementary education
[ ] 33. Secondary education
[ ] 34. Other, please specify ______________

5. Besides regular schooling, what other type of schooling, if any, do you think you most likely will finish? (Please check one or more.)

Type of Special Schooling

☐ 0. None [1:15]

☐ 1. Nursing school (for RN's only) [1:16]

☐ 2. Trade or craft such as mechanic, electrician, beautician, etc. [1:17]

☐ 3. Business or office work [1:18]

☐ 4. Science or engineering technology such as draftsman [1:19]

☐ 5. Agriculture school [1:20]

☐ 6. Home economics school [1:21]

☐ 7. Real estate [1:22]

☐ 8. Other, please specify [1:23]

6. Please list the name and some of the duties of the job that you now think you would most want to have for your main occupation over most of your life.

Name of Occupation	Duties or Tasks of Occupation

[1:24-26]

7. Disregarding what you would want, please list the name and some duties of the job that you think you are most likely to end up in for your main occupation over most of your life.

Name of Occupation	Duties or Tasks of Occupation

[1:27-29]

The next several questions ask about what kind of life-style you think you will follow as you get older.

8. Do you expect that you will get married someday? (Please check one.)

[1:30]

☐ 0. I am now married — Skip to question 11

☐ 1. Yes, quite sure I will marry

☐ 2. Yes, I probably will marry

☐ 3. Don't know

☐ 4. No, I probably won't marry

☐ 5. No, quite sure I won't marry

9. If you do get married, what is the youngest age you think you would be when you marry?

[1:31-32]

__________ youngest age

10. What is the oldest age you think you would be when you get married (if you get married)?

[1:33-34]

__________ oldest age

11. What is the fewest number of children you think you are likely to have? (If none, write 0.)

[1:35-36]

__________ fewest number of children

12. What is the most number of children you think you are likely to have?

[1:37-38]

__________ most number of children

13. What relative amount of energy do you expect to devote to your home life and to your work? (Please check one.)

[1:39]

Relative energy devoted to
home and to job

☐ 1. Much more energy devoted to home than to job

☐ 2. Somewhat more energy devoted to home than to job

☐ 3. About the same energy devoted to home as to job

☐ 4. Somewhat less energy devoted to home than to job

☐ 5. Much less energy devoted to home than to job

The next three questions concern your ideas about your future income. For all these questions, answer as if the VALUE OF THE DOLLAR STAYS THE SAME AS IT IS NOW. All three questions refer to the time in your life when you will make your highest income -- your peak earning years.

14. Assuming you work for pay after completing school, what is the total income per year you realistically expect to make?

[1:40-41]

INCOME RANGES

$ Per Year

- ☐ (1) Under $4,000
- ☐ (2) 4,000 to 5,999
- ☐ (3) 6,000 to 7,999
- ☐ (4) 8,000 to 9,999
- ☐ (5) 10,000 to 11,999
- ☐ (6) 12,000 to 14,999
- ☐ (7) 15,000 to 19,999
- ☐ (8) 20,000 to 24,999
- ☐ (9) 25,000 to 29,999
- ☐ (10) 30,000 to 34,999
- ☐ (11) 35,000 to 39,999
- ☐ (12) 40,000 or more

15. What about your future family income, including possible income of your husband or wife, or income from any other source? What is the highest income per year you realistically expect for your future family income?

[1:42-43]

INCOME RANGES

$ Per Year

☐ (1) Under $4,000
☐ (2) 4,000 to 5,999
☐ (3) 6,000 to 7,999
☐ (4) 8,000 to 9,999
☐ (5) 10,000 to 11,999
☐ (6) 12,000 to 14,999
☐ (7) 15,000 to 19,999
☐ (8) 20,000 to 24,999
☐ (9) 25,000 to 29,999
☐ (10) 30,000 to 34,999
☐ (11) 35,000 to 39,999
☐ (12) 40,000 or more

16. Compared to your parents, about how much income do you think you personally will make?

[1:44]

☐ 1. Much more than my parents

☐ 2. Somewhat more than my parents

☐ 3. About the same as my parents

☐ 4. Somewhat less than my parents

☐ 5. Much less than my parents

17. What about your future family income including money your wife or husband makes? Compared to your parents, about how much do you think your future family income will be?

[1:45]

☐ 1. Much more than my parents

☐ 2. Somewhat more than my parents

☐ 3. About the same as my parents

☐ 4. Somewhat less than my parents

☐ 5. Much less than my parents

18. At the time when you are earning your highest income, would you most likely think of yourself as: (check one)

[1:46]

☐ 1. Rich

☐ 2. Well-to-do

☐ 3. Middle income

☐ 4. Low-middle income

☐ 5. Low income

☐ 6. In poverty, or close to it

INSTRUCTIONS: This set of questions concerns your interest in different kinds of jobs. There are eight questions. You are to check ONE job in EACH question. Make sure it is the BEST ANSWER you can give to this question. Read each question carefully. They are all different. Do not omit any, EVEN IF YOU MUST GUESS. We realize that the lists may not contain any jobs you like. Please answer anyway, as if the jobs in the list were the only possible jobs.

19. Of the jobs listed in this question, which is the BEST ONE you are REALLY SURE YOU CAN GET when your SCHOOLING IS OVER?

[1:47-48]

☐ 1. Lawyer

☐ 2. Welfare worker for a city government

☐ 3. United States Representative in Congress

☐ 4. Corporal in the Army

☐ 5. U.S. Supreme Court Justice

☐ 6. Night watchman

☐ 7. Sociologist

☐ 8. Policeman

☐ 9. County agricultural agent

☐ 10. Filling station attendant

20. Of the jobs listed in this question, which ONE would you choose if you were FREE TO CHOOSE ANY of them you wished when your SCHOOLING IS OVER? [1:49-50]

[ ] 1. Member of the board of directors of a large corporation
[ ] 2. Undertaker
[ ] 3. Banker
[ ] 4. Machine operator in a factory
[ ] 5. Physician (doctor)
[ ] 6. Clothes presser in a laundry
[ ] 7. Accountant for a large business
[ ] 8. Railroad conductor
[ ] 9. Railroad engineer
[ ] 10. Singer in a night club

21. Of the jobs listed in this question, which is the BEST ONE you are REALLY SURE YOU CAN GET when your SCHOOLING IS OVER? [1:51-52]

[ ] 1. Nuclear physicist
[ ] 2. Reporter for a daily newspaper
[ ] 3. County judge
[ ] 4. Barber
[ ] 5. State Governor
[ ] 6. Soda fountain clerk
[ ] 7. Biologist
[ ] 8. Mail carrier
[ ] 9. Official of an international labor union
[ ] 10. Farm hand

22. Of the jobs listed in this question, which ONE would you choose if you were FREE TO CHOOSE ANY of them you wished when your SCHOOLING IS OVER? [1:53-54]

[ ] 1. Psychologist

[ ] 2. Manager of a small store in a city

[ ] 3. Head of a department in state government

[ ] 4. Clerk in a store

[ ] 5. Cabinet member in the federal government

[ ] 6. Janitor

[ ] 7. Musician in a symphony orchestra

[ ] 8. Carpenter

[ ] 9. Radio announcer

[ ] 10. Coal miner

23. Of the jobs listed in this question, which is the BEST ONE you are REALLY SURE YOU CAN HAVE by the time you are 30 YEARS OLD? [1:55-56]

[ ] 1. Civil engineer

[ ] 2. Bookkeeper

[ ] 3. Minister or priest

[ ] 4. Streetcar motor man or city bus driver

[ ] 5. Diplomat in the United States Foreign Service

[ ] 6. Sharecropper (one who owns no livestock or farm machinery and does not manage the farm)

[ ] 7. Author of novels

[ ] 8. Plumber

[ ] 9. Newspaper columnist

[ ] 10. Taxi driver

24. Of the jobs listed in this question, which ONE would you choose to have when you are 30 YEARS OLD, if you were FREE TO HAVE ANY of them you wished?

[1:57-58]

☐ 1. Airline pilot

☐ 2. Insurance agent

☐ 3. Architect

☐ 4. Milk route man

☐ 5. Mayor of a large city

☐ 6. Garbage collector

☐ 7. Captain in the army

☐ 8. Garage mechanic

☐ 9. Owner-operator of a printing shop

☐ 10. Railroad section hand

25. Of the jobs listed in this question, which is the BEST ONE you are REALLY SURE YOU CAN HAVE by the time you are 30 YEARS OLD?

[1:59-60]

☐ 1. Artist who paints pictures that are exhibited in galleries

☐ 2. Traveling salesman for a wholesale concern

☐ 3. Chemist

☐ 4. Truck driver

☐ 5. College professor

☐ 6. Street sweeper

☐ 7. Building contractor

☐ 8. Local official of a labor union

☐ 9. Electrician

☐ 10. Restaurant waiter

Form 2

26. Of the jobs listed in this question, which ONE would you choose to have when you are 30 YEARS OLD, if you were FREE TO CHOOSE ANY of them you wished?

[1:61-62]

☐ 1. Owner of a factory that employs about 100 people

☐ 2. Playground director

☐ 3. Dentist

☐ 4. Lumberjack

☐ 5. Scientist

☐ 6. Shoe shiner

☐ 7. Public school teacher

☐ 8. Owner-operator of a lunch stand

☐ 9. Trained machinist

☐ 10. Dock worker

If you were not in school last year, skip to question 28.

27. Last year at school, did you participate on a regular basis in any of the activities listed below? Please check all those you participated in.

☐ None [1:63]

☐ Band or orchestra [1:64]

☐ Choir or chorus [1:65]

☐ Drama (school plays, etc.) [1:66]

☐ School paper or yearbook [1:67]

☐ Language club (such as French, Spanish, German) [1:68]

☐ Hobby or interest club (such as photography, chess, radio) [1:69]

☐ Service activities (such as stage hand, band manager, athletic manager) [1:70]

☐ Member of student government or class officer [1:71]

☐ Academic honor club [1:72]

☐ Intramurual athletics [1:73]

Interschool athletics:

☐ Basketball [1:74]

☐ Football [1:75]

☐ Baseball [1:76]

☐ Track [1:77]

☐ Soccer [1:78]

☐ Swimming [2:08]

☐ Wrestling [2:09]

☐ Other interschool athletics [2:10]

☐ Other activities, Please list: [2:11]

1. ______________________

2. ______________________

3. ______________________

SECTION II

QUESTIONS ABOUT OTHER PEOPLE'S ATTITUDES TOWARD YOUR CAREER

> Please answer all questions in this section even if you aren't in school.

28. Do you think your parents want you to go to college? Please check one for your mother on the left and one for your father on the right.

[2:12] [2:13]

Mother	Father	
☐	☐	1. Yes, very much
☐	☐	2. Yes, somewhat
☐	☐	3. Neither yes nor no
☐	☐	4. No, prefer I not go
☐	☐	5. No, strongly opposed

29. Have your parents shared their desires with you by encouraging or discouraging you from going to college? Please check one for your mother on the left and one for your father on the right.

[2:14] [2:15]

Mother	Father	
☐	☐	1. Strongly discouraged
☐	☐	2. Discouraged somewhat
☐	☐	3. Neither discouraged nor encouraged
☐	☐	4. Encouraged somewhat
☐	☐	5. Strongly encouraged

30. Would you say that in your home it is just taken for granted that you will go to college? Please check one.

[2:16]

☐ 1. Yes

☐ 2. Not sure

☐ 3. No

Form 2

31. During the past year, about how often would you say you have discussed going to college with your parents? Please check one on the left for your mother and one on the right for your father.

[2:17] [2:18]

Mother	Father		
[ ]	[ ]	(1)	Hardly at all, if ever
[ ]	[ ]	(2)	2 or 3 times
[ ]	[ ]	(3)	4 to 6 times
[ ]	[ ]	(4)	at least 7 times, but less than once a month
[ ]	[ ]	(5)	average once a month or more

32. What is the highest grade of regular school that you think each of your parents expects you to finish? Please check one on the left for your mother and one on the right for your father.

[2:19-20] [2:21-22]

Mother	Father		Level of Regular School
[ ]	[ ]	10.	High school sophomore
[ ]	[ ]	11.	High school junior
[ ]	[ ]	12.	High school graduate
[ ]	[ ]	13.	College freshman
[ ]	[ ]	14.	College sophomore
[ ]	[ ]	15.	College junior
[ ]	[ ]	16.	College graduate (Bachelor's degree)
[ ]	[ ]	17.	Master's degree
[ ]	[ ]	18.	Ph.D. or professional degree such as medicine, law, or dentistry

33. If you had to guess, what would you say is the highest grade in regular school most of your teen age friends might think you will finish? (Please check one.)

[2:23-24]

Level of Regular School

[ ] 10. High school sophomore

[ ] 11. High school junior

[ ] 12. High school graduate

[ ] 13. College freshman

[ ] 14. College sophomore

[ ] 15. College junior

[ ] 16. College graduate (Bachelor's degree)

[ ] 17. Master's degree

[ ] 18. Ph.D. or professional degree such as medicine, law, or dentistry

34. Referring to jobs that you might have as your main occupation over most of your life, please list the name and duties of one occupation for each of the following cases. Don't leave any blank, even if you have to guess.

a. Occupation your mother expects is the most likely one you will end up in

name of occupation — duties or tasks of occupation

[2:25-27]

b. Occupation your father expects is the most likely one you will end up in

name of occupation — duties or tasks of occuaption

[2:28-30]

c. Occupation you think most of your teen age friends would be least surprised to find you in

name of occupation — duties or tasks of occupation

[2:31-33]

35. If you had to guess, what would you say is the highest yearly income each of your parents thinks you will ever make? Please check one on the left for your mother and one on the right for your father.

[2:34-35] [2:36-37]

INCOME RANGES

$ Per Year

Mother	Father		
[ ]	[ ]	(1)	Under $4,000
[ ]	[ ]	(2)	4,000 to 5,999
[ ]	[ ]	(3)	6,000 to 7,999
[ ]	[ ]	(4)	8,000 to 9,999
[ ]	[ ]	(5)	10,000 to 11,999
[ ]	[ ]	(6)	12,000 to 14,999
[ ]	[ ]	(7)	15,000 to 19,999
[ ]	[ ]	(8)	20,000 to 24,999
[ ]	[ ]	(9)	25,000 to 29,999
[ ]	[ ]	(10)	30,000 to 34,999
[ ]	[ ]	(11)	35,000 to 39,999
[ ]	[ ]	(12)	40,000 or more

SECTION III

WHAT YOU THINK OTHERS YOUR AGE ARE PLANNING

36. Referring to the people your own age who are your friends, which of the statements below best describes your guess about how many of them plan to go to college? (Check one only.)

[2:38]

☐ (1) 75% or more

☐ (2) 50% to 75%

☐ (3) 25% to 50%

☐ (4) less than 25%

37. What is the highest level of regular school that you think most of your teenage friends will complete? Please check one. We realize you can't be sure about this; we just want whatever ideas you have.

[2:39-40]

Level of Regular School

☐ 10. High school sophomore

☐ 11. High school junior

☐ 12. High school graduate

☐ 13. College freshman

☐ 14. College sophomore

☐ 15. College junior

☐ 16. College graduate (Bachelor's degree)

☐ 17. Master's degree

☐ 18. Ph.D. or professional degree such as medicine, law, or dentistry

38. Please list the name of an occupation that you would not be surprised to see most of your friends have as their main occupation over most of their lives. Also, please describe the main duties or tasks that people do in this occupation. Again, we realize that you cannot be sure about this; we just want whatever ideas you have.

Name of Occupation	Duties of Tasks of this Occupation
1. ______________________	____
	____

[2:41-43]

39. Do you think most of your teen age friends will be (check one):

[2:44]

- ☐ 1. Rich
- ☐ 2. Well-to-do
- ☐ 3. Middle income
- ☐ 4. Low-middle income
- ☐ 5. Low income
- ☐ 6. Poverty stricken or close to it

40. In major subjects (like English, math, or history) at school, how good a student would you say you are? (check one) (If you aren't in school, please say how good a student you think you would be if you went back to school.)

[2:45-46]

☐ 1. A+
☐ 2. A
☐ 3. A-
☐ 4. B+
☐ 5. B
☐ 6. B-
☐ 7. C+
☐ 8. C
☐ 9. C-
☐ 10. D+
☐ 11. D
☐ 12. D-
☐ 13. Below D-

If you aren't in school now, skip to question 42.

41. What type of school curriculum do you consider yourself to be in? Please check the one you feel you emphasize the most.

[2:47]

☐ Vocational education

☐ College preparation

☐ General education

☐ Other -- Please describe: ________________________________

42. When you started in high school as a sophomore, what curriculum were you in?

[2:48]

☐ Vocational education

☐ College preparation

☐ General education

☐ Other -- please describe: ________________________________

SECTION IV

BACKGROUND INFORMATION

Although the questions in this section are not directly related to your future career, they are vitally important to us. Please answer every question, even if you are not sure.

For all questions about your mother and father, please answer for the persons who are most like parents to you whether or not they are your real mother and father.

43. Please list your age in the blank.

____

[2:49-50]

44. To the best of your knowledge, what is the highest grade of regular school your mother and your father each finished and got credit for? Please check one on the left for your mother and one on the right for your father.

Mother	Father	Level of Regular School
☐	☐	0. Less than 1st grade
☐	☐	1. 1st grade
☐	☐	2. 2nd grade
☐	☐	3. 3rd grade
☐	☐	4. 4th grade
☐	☐	5. 5th grade
☐	☐	6. 6th grade
☐	☐	7. 7th grade
☐	☐	8. 8th grade
☐	☐	9. High school freshman
☐	☐	10. High school sophomore
☐	☐	11. High school junior
☐	☐	12. High school graduate
☐	☐	13. College freshman
☐	☐	14. College sophomore
☐	☐	15. College junior
☐	☐	16. College graduate (Bachelor's degree)
☐	☐	17. Master's degree
☐	☐	18. Ph.D. or professional degree such as medicine, law, or dentistry

[2:51-52] [2:53-54]

45. What is the name of your father's main occupation or job? (If he is not working now, write the name of his last job.)

[2:55-57]

____

____

Describe a little about what your father does (did) on this job. That is, what are some of his main duties?

____

____

46. What is the name of your mother's main occupation or job? (If she is not working now, write the name of her last job.)

[2:58-60]

____

____

Describe a little about what your mother does (did) on this job. That is what are some of her main duties?

____

____

Form 2

47. To be best of your knowledge, what will be your total family income this year? Please check one box beside the appropriate income range.

> NOTE: Total family income includes all income made by any family member living in your home. It includes not only wages and salaries, but also income from any other place, such as rent, interest, business profits, child support, or welfare payments.

[2:61-62]

INCOME RANGES

$ Per Year

[ ] (1) Under 4,000

[ ] (2) 4,000 to 5,999

[ ] (3) 6,000 to 7,999

[ ] (4) 8,000 to 9,999

[ ] (5) 10,000 to 11,999

[ ] (6) 12,000 to 14,999

[ ] (7) 15,000 to 19,999

[ ] (8) 20,000 to 24,999

[ ] (9) 25,000 to 29,999

[ ] (10) 30,000 to 34,999

[ ] (11) 35,000 to 39,999

[ ] (12) 40,000 or more

48. Please estimate your parents' ability to help pay for your college or other education after high school if you decide to go. (Check one.) Please answer even if you don't expect to attend school beyond high school.

[2:63]

[ ] 1. They can easily afford it

[ ] 2. They can afford it, but would have to sacrifice

[ ] 3. They cannot afford it at all

49. Please list the age of each of your brothers in the space below. If you're not sure, take a guess. (Include half brothers and anyone living with you who is like a brother to you.)

Age of each brother:

_____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____

[3:09-10] [3:11-43]

50. Please list the age of each of your sisters in the space below. If you're not sure, take a guess. (Include half sisters and anyone living with you who is like a sister to you.)

Age of each sister:

_____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____

[3:44-45] [3:46-78]

51. Go back to the previous two questions and circle the ages of brothers and sisters who have not lived with you over the past year. If none, check here [ ].

188

52. Are you currently enrolled in high school?

[ ] Yes

[ ] No

[4:08]

53. Please list the name of each high school you have attended and the dates that you attended each school.

NOTES: (1) If any school is located outside Columbus, be sure to list the city and state.

(2) If you attended more than one school at the same time, as with a career center and a regular school, list both schools.

Name of High School	Dates of Attendance	
	Start	End

[4:09...]

54. Please list all the jobs you have done for pay since September 1978 (the beginning of your sophomore year in high school). It is all right if the dates of some jobs overlap if you held more than one job at the same time.

[6:09...]

Name of Job	Duties of Job	Name of Company	Dates		Approx. Hourly Pay	Approx. Hours Per Week	Was Employer Related to You?	
			Start	End			Yes	No

Your participation in the Career Aspirations Survey is now complete. On behalf of The Ohio State University and the National Center for Research in Vocational Education, I wish to extend warm appreciation. Your cooperation has been invaluable to the success of this unique study.

- Lawrence Hotchkiss
Project Director

Protocol No. 78B 191
Forms 3, 5
Interview 3

OSU The Ohio State University

THE NATIONAL CENTER
FOR RESEARCH IN VOCATIONAL EDUCATION

1960 Kenny Road
Columbus, Ohio 43210

Phone: 614–486-3655
Cable: CTVOCEDOSU/Columbus, Ohio

ESTIMATING THE CHANCES

PARENT'S FORM

This survey continues the research on career aspirations in which you have participated twice already. The initial two phases of the study have been very successful, due in large part to your cooperation. To accomplish our major goal of studying changes in career aspirations, however, your continued participation is critical. We thank you for agreeing to this third home visit.

Please recall that when these questionnaires leave your home, no one will be allowed to see how you answered any question -- your answers are strictly confidential. DO NOT put your name on any questionnaire.

Again, thank you for helping us.

We recognize that it is hard for you to be sure about your child's future career. In this questionnaire, therefore, we ask you to estimate the chance that your son or daughter will obtain different occupational, educational and income options. Of course, you may not be sure about the chances either, but please give us your best guess for every question.

OCCUPATIONS

1. The next few pages contain a list of jobs with a line to the right of each job. We want you to use the line to guess the chance that each job will be your son's or daughter's main job for most of his or her life.

   Look at some of the questions to see how they are laid out, then read the directions below:

   a. Put one check on each line
   b. Place the check so that the farther to the right it is, the higher the chance that this occupation will be his or her main job
   c. Don't worry if most of your checks are near zero, this is normal

NAME OF JOB	CHANCE YOUR CHILD WILL BE IN THIS JOB (Place one check on each line)
Military officer [1:08]	0 ——————————————— 100
Military enlisted person, not an officer [1:11]	0 ——————————————— 100

NOTE: The remaining are civilian jobs only.

Accountant [1:14]	0 ——————————————— 100
Architect [1:17]	0 ——————————————— 100
Computer specialist (such as programmer) [1:20]	0 ——————————————— 100

Form 3, 5

NAME OF JOB	CHANCE YOUR CHILD WILL BE IN THIS JOB (Place one check on each line)
Forester or conservationist [1:23]	0 ———— 100
Judge [1:26]	0 ———— 100
Librarian or curator [1:29]	0 ———— 100
Physical scientist such as geologist or astronomer, but not an engineer, or a college professor [1:32]	0 ———— 100
Engineer such as chemical engineer or electrical engineer, but not a college professor [1:35]	0 ———— 100
Social scientist, such as psychologist, economist, or sociologist, but not a college professor [1:38]	0 ———— 100
Biological or agricultural scientist, but not a college professor [1:41]	0 ———— 100
Lawyer (but not a college professor) [1:44]	0 ———— 100
Physical, speech, or occupational therapist [1:47]	0 ———— 100

NAME OF JOB	CHANCE YOUR CHILD WILL BE IN THIS JOB (Place one check on each line)
Airplane pilot [1:50]	0 100
Air traffic controller or radio operator [1:53]	0 100
Flight engineer [1:56]	0 100
Designer, including designer of clothes, pottery, rugs, interior decorating, glassware [1:59]	0 100
Bank officer or financial manager [1:62]	0 100
Funeral director or embalmer [1:65]	0 100
Inspector such as building safety inspector or bank examiner [1:68]	0 100
Writer or author (fiction or nonfiction), journalist, reporter, editor, public relations person or publicity writer [1:71]	0 100
Postmaster or mail superintendent, sales manager, or health administrator [1:74]	0 100

Form 3, 5

NAME OF JOB	CHANCE YOUR CHILD WILL BE IN THIS JOB (Place one check on each line)
Railroad conductor, officer, or pilot of a ship, building manager or superintendent [1:77]	0 10
Storekeeper or restaurant, cafeteria, or bar manager *[2:08]	0 10
Corporation executive or college administrator such as college dean [2:11]	0 10
Receptionist or office machine operator such as computer, keypunch or telephone operator [2:14]	0 10
Clerical work such as file clerk, postal clerk, or stock clerk [2:17]	0 10
Blacksmith or boilermaker [2:20]	0 10
Operator of earth moving machinery and other heavy machinery such as bulldozer, grader, or crane [2:23]	0 10
Carpentry work such as cabinet maker or housebuilder [2:26]	0 10

Form 3, 5

NAME OF JOB	CHANCE YOUR CHILD WILL BE IN THIS JOB (Place one check on each line)
Bookbinder or typesetter in a print shop or related work [2:29]	0 100
Jeweler, watchmaker, machinist, optician, grinder, or polisher [2:32]	0 100
Tailor or upholsterer [2:35]	0 100
Tool and die maker [2:38]	0 100
Garage worker or gas station attendant [2:41]	0 100
Meatcutter, butcher, baker, or related work [2:44]	0 100
Operator of a precision machine such as lathe, drillpress, milling machine, or grinder [2:47]	0 100
Textile worker such as weaver [2:50]	0 100
High school or grade school administrator such as principal or superintendent [2:53]	0 100
Other administrator or manager such as union officer, office manager [2:56]	0 100
Labor negotiator (but not a union officer) [2:59]	0 100

Form 3, 5

NAME OF JOB	CHANCE YOUR CHILD WILL BE IN THIS JOB (Place one check on each line)
Bank teller, cashier in a store, or bookkeeper [2:62]	0 10
Vehicle dispatcher, such as taxicabs or police cars [2:65]	0 10
Insurance adjuster, examiner, or investigator [2:68]	0 10
Mail carrier, deliveryman, routeman or reader of gas or electric meters [2:71]	0 10
Auctioneer [2:74]	0 10
Insurance agent or underwriter [2:77]	0 10
Real estate agent or appraiser *[3:08]	0 10
Stock and bond salesman [3:11]	0 10
Sales clerk in a store or other salesperson [3:14]	0 10
Medical secretary [3:17]	0 10
Secretary or stenographer (except medical secretary) [3:20]	0 10

NAME OF JOB	CHANCE YOUR CHILD WILL BE IN THIS JOB (Place one check on each line)
Railroad brakeman or railroad switchman [3:23]	0 100
Garbage collector [3:26]	0 100
Longshoreman, stevedore, sailor, or deckhand [3:29]	0 100
Lumberman or related work such as working in a sawmill or miner, such as coal miner or other mine work [3:32]	0 100
Operator of a machine such as riviter, photo developer, welder or other type of worker [3:35]	0 100
Farmer or farm manager, farm foreman [3:38]	0 100
Farm laborer or self-employed farm service worker such as sheep shearer or combine operator [3:41]	0 100
Cleaning service worker in a business such as a hotel but not a private home -- such as janitor, cleaning woman, maid [3:44]	0 100
Office messenger, telegraph messenger, newsboy or newsgirl, or peddler [3:47]	0 100

NAME OF JOB	CHANCE YOUR CHILD WILL BE IN THIS JOB (Place one check on each line)
Food service worker such as bartender, busboy in a hotel, dishwasher, food counter or fountain worker or waiter or waitress [3:50]	0 ——— 10
Protective service worker such as fireman, policeman, detective, sheriff, or bailiff [3:53]	0 ——— 10
Worker in a family home -- such as cook, child care worker, housekeeper, maid, or butler [3:56]	0 ——— 10
Personal service worker such as airline stewardess baggage porter or bellhop, barber, boarding and lodging housekeeper, elevator operator, hairdresser or cosmetologist, usher [3:59]	0 ——— 10
Medical doctor or dentist [3:62]	0 ——— 10
Registered nurse or dietitian [3:65]	0 ——— 10
Optometrist (eye doctor) [3:68]	0 ——— 10
Pharmicist or druggist [3:71]	0 ——— 10
Veterinarian [3:74]	0 ——— 10

NAME OF JOB	CHANCE YOUR CHILD WILL BE IN THIS JOB (Place one check on each line)
Technical work related to health care, such as radiologic assistant, dental hygienist, therapy assistant, or laboratory technician [3:77]	0 100
Chiropractor, podiatrist (foot doctor) *[4:08]	0 100
Minister, priest, or rabbi (or other clergyman) [4:11]	0 100
Other religious worker [4:14]	0 100
Social worker or recreation worker [4:17]	0 100
Elementary school teacher (including Kindergarten and preschool) [4:20]	0 100
High school teacher, vocational or educational counselor [4:23]	0 100
Teacher aide [4:26]	0 100
Other type of teacher [4:29]	0 100
Science technician, surveyor, or draftsman [4:32]	0 100

NAME OF JOB	CHANCE YOUR CHILD WILL BE IN THIS JOB (Place one check on each line)
Health service worker with no college training such as practical nurse, medical technician, or dental assistant [4:35]	0 1
Locomotive engineer or fireman [4:38]	0 1
Auto mechanic or repairman of heavy equipment [4:41]	0 1
Household appliance, radio, television, or other mechanic or repairman [4:44]	0 1
Motion picture projectionist [4:47]	0 1
House painter or plasterer [4:50]	0 1
Piano or organ tuner or repairman [4:53]	0 1
Brick layer, electrician, plumber or related work [4:56]	0 10
Sheetmetal worker or tinsmith [4:59]	0 10
Shoe repairman or shoemaking machine operator [4:62]	0 10

NAME OF JOB	CHANCE YOUR CHILD WILL BE IN THIS JOB (Place one check on each line)
Sign painter or letterer [4:65]	0 100
College teacher or professor of sciences such as: physics, chemistry, astronomy, mathematics, geology, biology, agriculture, medicine, dentistry, pharmacy, or veterinary medicine [4:68]	0 100
College teacher or professor of nonsciences such as: psychology, economics, sociology, political science, law, history, English, language, education, business, commerce, industrial arts, sport coach or physical education, art, drama, music [4:71]	0 100
Entertainer or artist such as actor, dancer, musician, composer, painter, sculptor, photographer, radio or TV announcer, professional athlete [4:74]	0 100
Skilled or semiskilled craftsman, such as carpet installer, wallpaper hanger, foreman, telephone installer, repairman or lineman [4:77]	0 100

Form 3, 5

NAME OF JOB	CHANCE YOUR CHILD WILL BE IN THIS JOB (Place one check on each line)
Transport equipment operator such as parking attendant, bus driver, conductor or motorman on mass rail transport, taxicab driver, chauffer, or truck driver *[5:08]	0 ____________________ 100

SECTION II

INCOME

2. Please rate the chance that each of the boxes below includes the HIGHEST total yearly income (not just take-home pay) your child will ever make.

Assume the value of the dollar doesn't change.

Use the same method you did for jobs.

a. Put one check on each line

b. Place the check so that the farther to the right it is, the higher your child's chance that this will be the most he or she will ever make

c. Since only one income range can include the highest income your child will ever make, if you check very high on one, the rest necessarily must be low

IF YOU HAVE ANY QUESTIONS, PLEASE ASK

$ PER YEAR	CHANCE THIS IS THE HIGHEST INCOME YOUR CHILD WILL EVER MAKE (Place one check on each line)	
Under $4,000	0 —————————— 100	[5:11]
4,000 - 5,999	0 —————————— 100	[5:14]
6,000 - 7,999	0 —————————— 100	[5:17]
8,000 - 9,999	0 —————————— 100	[5:20]
10,000 - 11,999	0 —————————— 100	[5:23]
12,000 - 14,999	0 —————————— 100	[5:26]
15,000 - 19,999	0 —————————— 100	[5:29]
20,000 - 24,999	0 —————————— 100	[5:32]
25,000 - 29,999	0 —————————— 100	[5:35]
30,000 - 34,999	0 —————————— 100	[5:38]
35,000 - 39,999	0 —————————— 100	[5:41]
40,000 - or more	0 —————————— 100	[5:44]

SECTION III

EDUCATION

3. Please rate the chance that your child will leave school for good after completing each level listed below.

Use the same method you used for jobs and income.

- a. Place one check on each line
- b. Place the check so that the farther to the right it is, the higher you think your chance that this is the most education your child will get
- c. Since only one grade can be the highest your child will ever attend, if you check very high on one, the rest must necessarily be low

REGULAR SCHOOL LEVEL	CHANCE THIS WILL BE THE MOST SCHOOLING COMPLETED (Place one check on each line)	
High school sophomore	0 ——————————— 100	[5:47]
High school junior	0 ——————————— 100	[5:50]
High school senior	0 ——————————— 100	[5:53]
College freshman	0 ——————————— 100	[5:56]
College sophomore	0 ——————————— 100	[5:59]
College junior	0 ——————————— 100	[5:62]
College senior	0 ——————————— 100	[5:65]
Master's degree	0 ——————————— 100	[5:68]
Ph.D. or professional degree	0 ——————————— 100	[5:71]

4. Different types of special training are listed below next to measuring lines. Please rate the chance that your child will complete each one.

   a. Place one check on each line

   b. Place the check so that the farther to the right it is, the higher you think your child's chance is

   c. Since it is possible to complete more than one kind of special educational training, you can have more than one high check

IF YOU HAVE ANY QUESTIONS, PLEASE ASK

TYPE OF SPECIAL SCHOOLING	CHANCE OF COMPLETION (Place one check on each line)	
Nursing school (for RN's only)	0 ____________________ 100	*[6:08]
Trade or craft such as mechanic, electrician, beautician, etc.	0 ____________________ 100	[6:11]
Business or office work	0 ____________________ 100	[6:14]
Science or engineering technology such as draftsman	0 ____________________ 100	[6:17]
Agricultural school	0 ____________________ 100	[6:20]
Home economics school	0 ____________________ 100	[6:23]
Real estate	0 ____________________ 100	[6:26]
Other, please specify ____________ ____________	0 ____________________ 100	[6:29]

Protocol No. 78B 191
Form 4
Interview 3

OSU
The Ohio State University

THE NATIONAL CENTER
FOR RESEARCH IN VOCATIONAL EDUCATION

1960 Kenny Road
Columbus, Ohio 43210

Phone: 614—486-3655
Cable: CTVOCEDOSU/Columbus, Ohio

SURVEY OF MOTHERS
(or female guardians)

CAREER ASPIRATIONS

Form 4

SECTION I

QUESTIONS ABOUT YOUR SON OR DAUGHTER'S FUTURE

The questions in this section are about your hopes and expectations for the future career of your son or daughter. Please answer every question to the best of your ability, even if your child currently is not in school.

1. Do you want your child to go to college? (Please check one.)

[1:08]

- ☐ 1. Yes, very much
- ☐ 2. Yes, somewhat
- ☐ 3. Haven't made up my mind
- ☐ 4. No, prefer he or she didn't go
- ☐ 5. No, strongly opposed

2. Have you mentioned your desires to your child by encouraging or discouraging him/her from going to college?

[1:09]

- ☐ 1. Strongly discouraged
- ☐ 2. Discouraged somewhat
- ☐ 3. Neither discouraged nor encouraged
- ☐ 4. Encouraged somewhat
- ☐ 5. Strongly encouraged

3. Would you say that in your home it is just taken for granted that your child will go to college? (Please check one.)

[1:10]

- ☐ 1. Yes
- ☐ 2. Not sure
- ☐ 3. No

Form 4

4. About how often during the past year would you say you have discussed going to college with your child? (Please check one.)

[1:11]

☐ (1) Hardly at all, if ever

☐ (2) 2 or 3 times

☐ (3) 4 to 6 times

☐ (4) At least 7 times, but less than once a month

☐ (5) Average once a month or more

5. What is the highest level of regular school you want your son or daughter to finish? (Please check one.)

[1:12-13]

Level of Regular School

☐ 10. High school sophomore

☐ 11. High school junior

☐ 12. High school graduate

☐ 13. College freshman

☐ 14. College sophomore

☐ 15. College junior

☐ 16. College graduate (Bachelor's degree)

☐ 17. Master's degree

☐ 18. Ph.D. or professional degree such as medicine, law, or dentistry

6. Disregarding what you would want, what is the highest level of school you realistically think your son or daughter will finish? (Please check one.)

[1:14-15]

Level of Regular School

☐ 10. High school sophomore
☐ 11. High school junior
☐ 12. High school graduate
☐ 13. College freshman
☐ 14. College sophomore
☐ 15. College junior
☐ 16. College graduate (Bachelor's degree)
☐ 17. Master's degree
☐ 18. Ph.D. or professional degree such as medicine, law, or dentistry

If you don't expect your son or daughter to attend college (checked 10, 11, or 12), skip to question 8.

7. What subject do you think your son or daughter most likely will study for his or her highest level of schooling? (Please check one.)
[1:16-17]

Note: If you expect your child will study two or more majors or you aren't sure, place a number in the bracket beside your choice. Use one (1) to indicate most likely choice or most important subject, a two (2) to indicate second choice, and so on.

[ ] 1. Business and Administration
[ ] 2. Agriculture
[ ] 3. Home economics
[ ] 4. Art (painting, sculpture, theater)
[ ] 5. Music
[ ] 6. Biology
[ ] 7. Black studies
[ ] 8. English
[ ] 9. Foreign language
[ ] 10. History
[ ] 11. Philosophy
[ ] 12. Astronomy
[ ] 13. Chemistry
[ ] 14. Mathematics
[ ] 15. Physics
[ ] 16. Statistics
[ ] 17. Anthropology
[ ] 18. Economics
[ ] 19. Political science
[ ] 20. Psychology
[ ] 21. Sociology
[ ] 22. Journalism
[ ] 23. Engineering
[ ] 24. Architecture
[ ] 25. Law
[ ] 26. Medicine
[ ] 27. Dentistry
[ ] 28. Veterinary medicine
[ ] 29. Seminary (preachers, priests, rabbis)
[ ] 30. Pharmacy
[ ] 31. Social work
[ ] 32. Elementary education
[ ] 33. Secondary education
[ ] 34. Other, please specify ____________________

8. Besides regular schooling, what other types of schooling, if any, do you think your child most likely will finish? Check as many as apply.

Type of Special Schooling

☐ 0. None [1:18]
☐ 1. Nursing school (for RN's only) [1:19]
☐ 2. Trade or craft such as mechanic, electrician, beautician, etc. [1:20]
☐ 3. Business or office work [1:21]
☐ 4. Science or engineering technology such as draftsman [1:22]
☐ 5. Agriculture school [1:23]
☐ 6. Home economics school [1:24]
☐ 7. Real estate [1:25]
☐ 8. Other, please specify ______________________________ [1:26]

9. Please list the name and some of the duties of the job that you think you would most want to see your son/daughter have as a main occupation for most of his/her life.

Name of Occupation	Duties of Occupation
______________________________	______________________________
	______________________________
	[1:27-29]

10. Disregarding what you would want, please list the name and some of the duties of the job that you think your son/daughter is most likely to end up in as a main occupation over most of his/her life.

Name of Occupation	Duties of Occupation
______________________________	______________________________
	______________________________
	[1:30-32]

11. Do you expect that your son or daughter will get married? (Please check one.) [1:33]

[ ] 0. My child is now married | Skip to question 14. |

[ ] 1. Yes, quite sure my child will marry

[ ] 2. Yes, my child probably will marry

[ ] 3. Don't know

[ ] 4. No, my child probably won't marry

[ ] 5. No, quite sure my child won't marry

12. If your son or daughter gets married, what is the youngest age you think he/she will be? [1:34-35]

__________ youngest age

13. What is the oldest age you think he/she will be? [1:36-37]

__________ oldest age

14. What is the fewest number of children you expect your son or daughter will have? (If none, write 0.) [1:38-39]

__________ fewest number of children

15. What is the largest number of children you expect he/she will have? [1:40-41]

__________ largest number of children

16. What relative amount of energy would you expect your child will devote to home life and to work? [1:42]

Relative energy devoted to home and to job

[ ] 1. Much more energy devoted to home than to job

[ ] 2. Somewhat more energy devoted to home than to job

[ ] 3. About the same energy devoted to home as to job

[ ] 4. Somewhat less energy devoted to home than to job

[ ] 5. Much less energy devoted to home than to job

The next three questions concern your ideas about your child's future income. For all these questions, answer as if the VALUE OF THE DOLLAR STAYS THE SAME AS IT IS NOW. All three questions refer to the time in your child's life when he/she will make the most income--the peak earnings years.

17. Assuming your child works for pay after completing school, what is the total income per year you think he/she will make? (Please check one below.)

[1:43-44]

INCOME RANGES

$ Per Year

☐ (1) Under $4,000
☐ (2) 4,000 to 5,999
☐ (3) 6,000 to 7,999
☐ (4) 8,000 to 9,999
☐ (5) 10,000 to 11,999
☐ (6) 12,000 to 14,999
☐ (7) 15,000 to 19,999
☐ (8) 20,000 to 24,999
☐ (9) 25,000 to 29,999
☐ (10) 30,000 to 34,999
☐ (11) 35,000 to 39,999
☐ (12) 40,000 or more

18. What about your child's future family income, including possible income from a wife or husband, or income from any other source. What is the highest income per year you think your son or daughter realistically will have? (Please check one below.)

[1:45-46]

INCOME RANGES

$ Per Year

☐ (1) Under $4,000
☐ (2) 4,000 to 5,999
☐ (3) 6,000 to 7,999
☐ (4) 8,000 to 9,999
☐ (5) 10,000 to 11,999
☐ (6) 12,000 to 14,999
☐ (7) 15,000 to 19,999
☐ (8) 20,000 to 24,999
☐ (9) 25,000 to 29,999
☐ (10) 30,000 to 34,999
☐ (11) 35,000 to 39,999
☐ (12) 40,000 or more

19. At the time when your child is earning his/her highest income, would you think he/she most likely will be: (check one)

[1:47]

☐ 1. Rich
☐ 2. Well-to-do
☐ 3. Middle income
☐ 4. Low income
☐ 5. In poverty, or close to it

Form 4

INSTRUCTIONS: This set of questions concerns your interest in different kinds of jobs for your son or daughter.

There are eight questions. You are to check ONE job in EACH question. Make sure it is the BEST ANSWER you can give to this question.

Read each question carefully. They are all different. Do not omit any, EVEN IF YOU MUST GUESS. We realize that the lists may not contain any jobs you like. Please answer anyway as if the jobs in the list were the only possible jobs.

20. Of the jobs listed in this question, which is the BEST ONE you are REALLY SURE HE/SHE CAN GET when his/her SCHOOLING IS OVER.

[1:48-49]

☐ 1. Lawyer

☐ 2. Welfare worker for a city government

☐ 3. United States Representative in Congress

☐ 4. Corporal in the Army

☐ 5. United States Supreme Court Justice

☐ 6. Night watchman

☐ 7. Sociologist

☐ 8. Policeman

☐ 9. County agricultural agent

☐ 10. Filling station attendant

21. Of the jobs listed in this question, which ONE would you most like to see him/her have if he/she were FREE TO CHOOSE ANY of them he/she wished when his/her SCHOOLING IS OVER?

[1:50-51]

☐ 1. Member of the board of directors of a large corporation
☐ 2. Undertaker
☐ 3. Banker
☐ 4. Machine operator in a factory
☐ 5. Physician (doctor)
☐ 6. Clothes presser in a laundry
☐ 7. Accountant for a large business
☐ 8. Railroad conductor
☐ 9. Railroad engineer
☐ 10. Singer in a night club

22. Of the jobs listed in this question, which is the BEST ONE you are REALLY SURE HE/SHE CAN GET when his/her SCHOOLING IS OVER?

[1:52-53]

☐ 1. Nuclear physicist
☐ 2. Reporter for a daily newspaper
☐ 3. County judge
☐ 4. Barber
☐ 5. State governor
☐ 6. Soda fountain clerk
☐ 7. Biologist
☐ 8. Mail carrier
☐ 9. Official of an international labor union
☐ 10. Farm hand

23. Of the jobs listed in this question, which ONE would you most like to see him/her have if he/she were FREE TO CHOOSE ANY of them he/she wished when his/her SCHOOLING IS OVER?

[1:54-55]

☐ 1. Psychologist
☐ 2. Manager of a small store in a city
☐ 3. Head of a department in state government
☐ 4. Clerk in a store
☐ 5. Cabinet member in the federal government
☐ 6. Janitor
☐ 7. Musician in a symphony orchestra
☐ 8. Carpenter
☐ 9. Radio announcer
☐ 10. Coal miner

24. Of the jobs listed in this question, which is the BEST ONE you are REALLY SURE HE/SHE CAN GET by the time he/she is 30 YEARS OLD?

[1:56-57]

☐ 1. Civil engineer
☐ 2. Bookkeeper
☐ 3. Minister or priest
☐ 4. Streetcar motorman or city bus driver
☐ 5. Diplomat in the United States Foreign Service
☐ 6. Sharecropper (one who owns no livestock or farm machinery, and does not manage the farm)
☐ 7. Author of novels
☐ 8. Plumber
☐ 9. Newspaper columnist
☐ 10. Taxi driver

25. Of the jobs listed in this question, which ONE would you like to see him/her have when he/she is 30 YEARS OLD, if he/she were FREE TO CHOOSE ANY of them he/she wished?

[1:58-59]

- ☐ 1. Airline pilot
- ☐ 2. Insurance agent
- ☐ 3. Architect
- ☐ 4. Milk route man
- ☐ 5. Mayor of a large city
- ☐ 6. Garbage collector
- ☐ 7. Captain in the Army
- ☐ 8. Garage mechanic
- ☐ 9. Owner-operator of a printing shop
- ☐ 10. Railroad section hand

26. Of the jobs listed in this question, which is the BEST ONE you are REALLY SURE HE/SHE CAN HAVE by the time he/she is 30 YEARS OLD?

[1:60-61]

- ☐ 1. Artist who paints pictures that are exhibited in galleries
- ☐ 2. Traveling salesman for a wholesale concern
- ☐ 3. Chemist
- ☐ 4. Truck driver
- ☐ 5. College professor
- ☐ 6. Street sweeper
- ☐ 7. Building contractor
- ☐ 8. Local official of a labor union
- ☐ 9. Electrician
- ☐ 10. Restaurant waiter

27. Of the jobs listed in this question, which ONE would you like to see him/her have when he/she is 30 YEARS OLD, if he/she were FREE TO HAVE ANY of them he wished?

[1:62-63]

[ ] 1. Owner of a factory that employs about 100 people

[ ] 2. Playground director

[ ] 3. Dentist

[ ] 4. Lumberjack

[ ] 5. Scientist

[ ] 6. Shoeshiner

[ ] 7. Public school teacher

[ ] 8. Owner-operator of a lunch stand

[ ] 9. Trained machinist

[ ] 10. Dock worker

SECTION II

BACKGROUND INFORMATION

Although the questions in this section are not directly related to your child's future, they are vitally important to us. Please answer every question even if you are not sure.

28. Are you now married, widowed, divorced, separated, or have you never been married?

[1:64]

☐ 1. Now married
☐ 2. Widowed (husband died and you have not remarried)
☐ 3. Divorced (and not remarried since)
☐ 4. Separated
☐ 5. Never married (include annulment here)

NOTE: If your husband lives away from home for business reasons, consider yourself "now married" rather than "separated".

29. Please check the highest level of regular school you have finished and gotten credit for?

[1:65-66]

Level of Regular School

☐ 0. Less than 1st grade

☐ 1. 1st grade

☐ 2. 2nd grade

☐ 3. 3rd grade

☐ 4. 4th grade

☐ 5. 5th grade

☐ 6. 6th grade

☐ 7. 7th grade

☐ 8. 8th grade

☐ 9. High school freshman

☐ 10. High school sophomore

☐ 11. High school junior

☐ 12. High school graduate

☐ 13. College freshman

☐ 14. College sophomore

☐ 15. College junior

☐ 16. College graduate (Bachelor's degree)

☐ 17. Master's degree

☐ 18. Ph.D. or professional degree such as medicine, law, or dentistry

30. Are you now employed, a homemaker, a student, or what? Please check as many as apply to you.

☐ 1. Working fulltime for pay (either in your home or outside your home) [1:67]

☐ 2. Working parttime for pay (either in your home or outside your home) [1:68]

☐ 3. In school (at least half time) [1:69]

☐ 4. Keeping house [1:70]

☐ 5. Retired [1:71]

6. Other, please specify ______________________ [1:72]

> If you are not now working for pay, skip to question 36.

31. What is the name of the place where you work? [1:73-75]

____

32. What is your present main occupation or job called? [1:76-78]

____

____

Describe a little about what you do in this job. That is, what are some of your main duties or tasks?

____

____

33. Do you work for yourself or someone else? (Consider that you work for yourself if you work for a corporation in which you own 15% or more of the stock.) (Please check one.)

[1:79]

[ ] 1. Work for someone else

[ ] 2. Work for myself in my own professional practice (such as law or medicine)

[ ] 3. Work for myself in my own business (except professional practice)

If you work for someone else, skip to question 36.

34. If you work for yourself, how many people work for you and are paid by you? If none, write 0.

[2:08-12]

__________ number who work for you

35. How many paid workers do you personally supervise on a regular basis as part of your job? If none, write 0.

[2:13-17]

__________ number of persons you supervise

The next question asks about your family income this year. We only want a range, not an exact amount. Remember, your answers will never be shown to anyone--they are strictly confidential.

36. To the best of your knowledge, which income range below includes your total family income for 1980? Please check one of the boxes.

[2:18-19]

NOTE: Total family income includes all income made by any family member living in your home. It includes not only wages and salaries, but also income from any other place, such as rent, interest, business profits, child support, or welfare payments.

INCOME RANGES

$ Per Year

[ ] (1) Under $4,000
[ ] (2) 4,000 to 5,999
[ ] (3) 6,000 to 7,999
[ ] (4) 8,000 to 9,999
[ ] (5) 10,000 to 11,999
[ ] (6) 12,000 to 14,999
[ ] (7) 15,000 to 19,999
[ ] (8) 20,000 to 24,999
[ ] (9) 25,000 to 29,999
[ ] (10) 30,000 to 34,999
[ ] (11) 35,000 to 39,999
[ ] (12) 40,000 or more

Your participation in the Career Aspirations Survey is now complete. On behalf of The Ohio State University and The National Center for Research in Vocational Education, I wish to extend warm appreciation. Your cooperation has been invaluable to the success of this unique study.

Lawrence Hotchkiss
Project Director

Protocol No. 78B 191
Form 6
Interview 3

OSU The Ohio State University

THE NATIONAL CENTER
FOR RESEARCH IN VOCATIONAL EDUCATION

1960 Kenny Road
Columbus, Ohio 43210

Phone: 614—486-3655
Cable: CTVOCEDOSU/Columbus, Ohio

SURVEY OF FATHERS
(or male guardians)

CAREER ASPIRATIONS

Form 6

SECTION I

QUESTIONS ABOUT YOUR SON OR DAUGHTER'S FUTURE

The questions in this section are about your hopes and expectations for the future career of your son or daughter. Please answer every question to the best of your ability, even if your child currently is not in school.

1. Do you want your child to go to college? (Please check one.) [1:08]

   - ☐ 1. Yes, very much
   - ☐ 2. Yes, somewhat
   - ☐ 3. Haven't made up my mind
   - ☐ 4. No, prefer he or she didn't go
   - ☐ 5. No, strongly opposed

2. Have you mentioned your desires to your child by encouraging or discouraging him/her from going to college? [1:09]

   - ☐ 1. Strongly discouraged
   - ☐ 2. Discouraged somewhat
   - ☐ 3. Neither discouraged nor encouraged
   - ☐ 4. Encouraged somewhat
   - ☐ 5. Strongly encouraged

3. Would you say that in your home it is just taken for granted that your child will go to college? (Please check one.) [1:10]

   - ☐ 1. Yes
   - ☐ 2. Not sure
   - ☐ 3. No

4. About how often during the past year would you say you have discussed going to college with your child? (Please check one.)

[1:11]

☐ (1) Hardly at all, if ever

☐ (2) 2 or 3 times

☐ (3) 4 to 6 times

☐ (4) At least 7 times, but less than once a month

☐ (5) Average once a month or more

5. What is the highest level of regular school you want your son or daughter to finish? (Please check one.)

[1:12-13]

Level of Regular School

☐ 10. High school sophomore

☐ 11. High school junior

☐ 12. High school graduate

☐ 13. College freshman

☐ 14. College sophomore

☐ 15. College junior

☐ 16. College graduate (Bachelor's degree)

☐ 17. Master's degree

☐ 18. Ph.D. or professional degree such as medicine, law, or dentistry

6. Disregarding what you would want, what is the highest level of school you realistically think your son or daughter will finish? (Please check one.)

[1:14-15]

Level of Regular School

☐ 10. High school sophomore
☐ 11. High school junior
☐ 12. High school graduate
☐ 13. College freshman
☐ 14. College sophomore
☐ 15. College junior
☐ 16. College graduate (Bachelor's degree)
☐ 17. Master's degree
☐ 18. Ph.D. or professional degree such as medicine, law, or dentistry

If you don't expect your son or daughter to attend college (checked 10, 11, or 12), skip to question 8.

7. What subject do you think your son or daughter most likely will study for his or her highest level of schooling? (Please check one.) [1:16-17]

> **Note:** If you expect your child will study two or more majors or you aren't sure, place a number in the bracket beside your choice. Use one (1) to indicate most likely choice or most important subject, a two (2) to indicate second choice, and so on.

☐ 1. Business and Administration
☐ 2. Agriculture
☐ 3. Home economics
☐ 4. Art (painting, sculpture, theater)
☐ 5. Music
☐ 6. Biology
☐ 7. Black studies
☐ 8. English
☐ 9. Foreign language
☐ 10. History
☐ 11. Philosophy
☐ 12. Astronomy
☐ 13. Chemistry
☐ 14. Mathematics
☐ 15. Physics
☐ 16. Statistics
☐ 17. Anthropology
☐ 18. Economics
☐ 19. Political science
☐ 20. Psychology
☐ 21. Sociology
☐ 22. Journalism
☐ 23. Engineering
☐ 24. Architecture
☐ 25. Law
☐ 26. Medicine
☐ 27. Dentistry
☐ 28. Veterinary medicine
☐ 29. Seminary (preachers, priests, rabbis)
☐ 30. Pharmacy
☐ 31. Social work
☐ 32. Elementary education
☐ 33. Secondary education
☐ 34. Other, please specify ____________________

8. Besides regular schooling, what other types of schooling, if any, do you think your child most likely will finish? Check as many as apply.

Type of Special Schooling

☐ 0. None [1:18]
☐ 1. Nursing school (for RN's only) [1:19]
☐ 2. Trade or craft such as mechanic, electrician, beautician, etc. [1:20]
☐ 3. Business or office work [1:21]
☐ 4. Science or engineering technology such as draftsman [1:22]
☐ 5. Agriculture school [1:23]
☐ 6. Home economics school [1:24]
☐ 7. Real estate [1:25]
☐ 8. Other, please specify ______________________ [1:26]

9. Please list the name and some of the duties of the job that you think you would most want to see your son/daughter have as a main occupation for most of his/her life.

Name of Occupation	Duties of Occupation
______________________	______________________
	______________________
	[1:27-29]

10. Disregarding what you would want, please list the name and some of the duties of the job that you think your son/daughter is most likely to end up in as a main occupation over most of his/her life.

Name of Occupation	Duties of Occupation
______________________	______________________
	______________________
	[1:30-32]

11. Do you expect that your son or daughter will get married? (Please check one.) [1:33]

[ ] 0. My child is now married Skip to question 14.

[ ] 1. Yes, quite sure my child will marry

[ ] 2. Yes, my child probably will marry

[ ] 3. Don't know

[ ] 4. No, my child probably won't marry

[ ] 5. No, quite sure my child won't marry

12. If your son or daughter gets married, what is the youngest age you think he/she will be? [1:34-35]

__________ youngest age

13. What is the oldest age you think he/she will be? [1:36-37]

__________ oldest age

14. What is the fewest number of children you expect your son or daughter will have? (If none, write 0.) [1:38-39]

__________ fewest number of children

15. What is the largest number of children you expect he/she will have? [1:40-41]

__________ largest number of children

16. What relative amount of energy would you expect your child will devote to home life and to work? [1:42]

Relative energy devoted to home and to job

[ ] 1. Much more energy devoted to home than to job

[ ] 2. Somewhat more energy devoted to home than to job

[ ] 3. About the same energy devoted to home as to job

[ ] 4. Somewhat less energy devoted to home than to job

[ ] 5. Much less energy devoted to home than to job

The next three questions concern your ideas about your child's future income. For all these questions, answer as if the VALUE OF THE DOLLAR STAYS THE SAME AS IT IS NOW. All three questions refer to the time in your child's life when he/she will make the most income--the peak earnings years.

17. Assuming your child works for pay after completing school, what is the total income per year you think he/she will make? (Please check one below.)

[1:43-44]

INCOME RANGES

$ Per Year

☐ (1) Under $4,000
☐ (2) 4,000 to 5,999
☐ (3) 6,000 to 7,999
☐ (4) 8,000 to 9,999
☐ (5) 10,000 to 11,999
☐ (6) 12,000 to 14,999
☐ (7) 15,000 to 19,999
☐ (8) 20,000 to 24,999
☐ (9) 25,000 to 29,999
☐ (10) 30,000 to 34,999
☐ (11) 35,000 to 39,999
☐ (12) 40,000 or more

18. What about your child's future family income, including possible income from a wife or husband, or income from any other source. What is the highest income per year you think your son or daughter realistically will have? (Please check one below.)

[1:45-46]

INCOME RANGES

$ Per Year

☐ (1) Under $4,000
☐ (2) 4,000 to 5,999
☐ (3) 6,000 to 7,999
☐ (4) 8,000 to 9,999
☐ (5) 10,000 to 11,999
☐ (6) 12,000 to 14,999
☐ (7) 15,000 to 19,999
☐ (8) 20,000 to 24,999
☐ (9) 25,000 to 29,999
☐ (10) 30,000 to 34,999
☐ (11) 35,000 to 39,999
☐ (12) 40,000 or more

19. At the time when your child is earning his/her highest income, would you think he/she most likely will be: (check one)

[1:47]

☐ 1. Rich
☐ 2. Well-to-do
☐ 3. Middle income
☐ 4. Low-middle income
☐ 5. Low income
☐ 6. In poverty, or close to it

INSTRUCTIONS: This set of questions concerns your interest in different kinds of jobs for your son or daughter.

There are eight questions. You are to check ONE job in EACH question. Make sure it is the BEST ANSWER you can give to this question.

Read each question carefully. They are all different. Do not omit any, EVEN IF YOU MUST GUESS. We realize that the lists may not contain any jobs you like. Please answer anyway as if the jobs in the list were the only possible jobs.

20. Of the jobs listed in this question, which is the BEST ONE you are REALLY SURE HE/SHE CAN GET when his/her SCHOOLING IS OVER. [1:48-49]

☐ 1. Lawyer

☐ 2. Welfare worker for a city government

☐ 3. United States Representative in Congress

☐ 4. Corporal in the Army

☐ 5. United States Supreme Court Justice

☐ 6. Night watchman

☐ 7. Sociologist

☐ 8. Policeman

☐ 9. County agricultural agent

☐ 10. Filling station attendant

21. Of the jobs listed in this question, which ONE would you most like to see him/her have if he/she were FREE TO CHOOSE ANY of them he/she wished when his/her SCHOOLING IS OVER?

[1:50-51]

☐ 1. Member of the board of directors of a large corporation

☐ 2. Undertaker

☐ 3. Banker ✓3

☐ 4. Machine operator in a factory

☐ 5. Physician (doctor)

☐ 6. Clothes presser in a laundry

☐ 7. Accountant for a large business

☐ 8. Railroad conductor

☐ 9. Railroad engineer

☐ 10. Singer in a night club

22. Of the jobs listed in this question, which is the BEST ONE you are REALLY SURE HE/SHE CAN GET when his/her SCHOOLING IS OVER?

[1:52-53]

☐ 1. Nuclear physicist

☐ 2. Reporter for a daily newspaper

☐ 3. County judge

☐ 4. Barber

☐ 5. State governor

☐ 6. Soda fountain clerk

☐ 7. Biologist

☐ 8. Mail carrier

☐ 9. Official of an international labor union

☐ 10. Farm hand

23. Of the jobs listed in this question, which ONE would you most like to see him/her have if he/she were FREE TO CHOOSE ANY of them he/she wished when his/her SCHOOLING IS OVER?

[1:54-55]

[ ] 1. Psychologist

[ ] 2. Manager of a small store in a city

[ ] 3. Head of a department in state government

[ ] 4. Clerk in a store

[ ] 5. Cabinet member in the federal government

[ ] 6. Janitor

[ ] 7. Musician in a symphony orchestra

[ ] 8. Carpenter

[ ] 9. Radio announcer

[ ] 10. Coal miner

24. Of the jobs listed in this question, which is the BEST ONE you are REALLY SURE HE/SHE CAN GET by the time he/she is 30 YEARS OLD?

[1:56-57]

[ ] 1. Civil engineer

[ ] 2. Bookkeeper

[ ] 3. Minister or priest

[ ] 4. Streetcar motorman or city bus driver

[ ] 5. Diplomat in the United States Foreign Service

[ ] 6. Sharecropper (one who owns no livestock or farm machinery, and does not manage the farm)

[ ] 7. Author of novels

[ ] 8. Plumber

[ ] 9. Newspaper columnist

[ ] 10. Taxi driver

25. Of the jobs listed in this question, which ONE would you like to see him/her have when he/she is 30 YEARS OLD, if he/she were FREE TO CHOOSE ANY of them he/she wished?

[1:58-59]

[ ] 1. Airline pilot

[ ] 2. Insurance agent

[ ] 3. Architect

[ ] 4. Milk route man

[ ] 5. Mayor of a large city

[ ] 6. Garbage collector

[ ] 7. Captain in the Army

[ ] 8. Garage mechanic

[ ] 9. Owner-operator of a printing shop

[ ] 10. Railroad section hand

26. Of the jobs listed in this question, which is the BEST ONE you are REALLY SURE HE/SHE CAN HAVE by the time he/she is 30 YEARS OLD?

[1:60-61]

[ ] 1. Artist who paints pictures that are exhibited in galleries

[ ] 2. Traveling salesman for a wholesale concern

[ ] 3. Chemist

[ ] 4. Truck driver

[ ] 5. College professor

[ ] 6. Street sweeper

[ ] 7. Building contractor

[ ] 8. Local official of a labor union

[ ] 9. Electrician

[ ] 10. Restaurant waiter

27. Of the jobs listed in this question, which ONE would you like to see him/her have when he/she is 30 YEARS OLD, if he/she were FREE TO HAVE ANY of them he wished?

[1:62-63]

☐ 1. Owner of a factory that employs about 100 people
☐ 2. Playground director
☐ 3. Dentist
☐ 4. Lumberjack
☐ 5. Scientist
☐ 6. Shoeshiner
☐ 7. Public school teacher
☐ 8. Owner-operator of a lunch stand
☐ 9. Trained machinist
☐ 10. Dock worker

SECTION II

BACKGROUND INFORMATION

Although the questions in this section are not directly related to your child's future, they are vitally important to us. Please answer every question even if you are not sure.

28. Are you now married, widowed, divorced, separated, or have you never been married?

(1:64)

( ) 1. Now married

( ) 2. Widower (wife died and you have not remarried)

( ) 3. Divorced (and not remarried since)

( ) 4. Separated

( ) 5. Never married (include annulment here)

NOTE: If your wife lives away from home for business reasons, consider yourself "now married" rather than "separated".

29. Please check the highest level of regular school you have finished and gotten credit for?

[1:65-66]

Level of Regular School

[ ] 0. Less than 1st grade

[ ] 1. 1st grade

[ ] 2. 2nd grade

[ ] 3. 3rd grade

[ ] 4. 4th grade

[ ] 5. 5th grade

[ ] 6. 6th grade

[ ] 7. 7th grade

[ ] 8. 8th grade

[ ] 9. High school freshman

[ ] 10. High school sophomore

[ ] 11. High school junior

[ ] 12. High school graduate

[ ] 13. College freshman

[ ] 14. College sophomore

[ ] 15. College junior

[ ] 16. College graduate (Bachelor's degree)

[ ] 17. Master's degree

[ ] 18. Ph.D. or professional degree such as medicine, law, or dentistry

30. Are you now employed, a homemaker, a student, or what? Please check as many as apply to you.

☐ 1. Working fulltime for pay (either in your home or outside your home) [1:67]

☐ 2. Working parttime for pay (either in your home or outside your home) [1:68]

☐ 3. In school (at least half time) [1:69]

☐ 4. Keeping house [1:70]

☐ 5. Retired [1:71]

6. Other, please specify ______________________________ [1:72]

If you are not now working for pay, skip to question 36.

31. What is the name of the place where you work? [1:73-75]

____

32. What is your present main occupation or job called? [1:76-78]

____

____

Describe a little about what you do in this job. That is, what are some of your main duties or tasks?

____

____

33. Do you work for yourself or someone else? (Consider that you work for yourself if you work for a corporation in which you own 15% or more of the stock.) (Please check one.)

[1:79]

☐ 1. Work for someone else

☐ 2. Work for myself in my own professional practice (such as law or medicine)

☐ 3. Work for myself in my own business (except professional practice)

If you work for someone else, skip to question 36.

34. If you work for yourself, how many people work for you and are paid by you? If none, write 0.

[2:08-12]

__________ number who work for you

35. How many paid workers do you personally supervise on a regular basis as part of your job? If none, write 0.

[2:13-17]

__________ number of persons you supervise

The next question asks about your family income this year. We only want a range, not an exact amount. Remember, your answers will never be shown to anyone--they are strictly confidential.

36. To the best of your knowledge, which income range below includes your total family income for 1980? Please check one of the boxes.

[2:18-19]

NOTE: Total family income includes all income made by any family member living in your home. It includes not only wages and salaries, but also income from any other place, such as rent, interest, business profits, child support, or welfare payments.

INCOME RANGES

$ Per Year

☐ (1) Under $4,000

☐ (2) 4,000 to 5,999

☐ (3) 6,000 to 7,999

☐ (4) 8,000 to 9,999

☐ (5) 10,000 to 11,999

☐ (6) 12,000 to 14,999

☐ (7) 15,000 to 19,999

☐ (8) 20,000 to 24,999

☐ (9) 25,000 to 29,999

☐ (10) 30,000 to 34,999

☐ (11) 35,000 to 39,999

☐ (12) 40,000 or more

Your participation in the Career Aspirations Survey is now complete. On behalf of The Ohio State University and The National Center for Research in Vocational Education, I wish to extend warm appreciation. Your cooperation has been invaluable to the success of this unique study.

Lawrence Hotchkiss
Project Director

REFERENCES

Alexander, Karl and Eckland, Bruce K. "Basic Attainment Processes: A Replication and Extension." Sociology of Education 48(1975): 457-495.

Alwin, Duane F. and Hauser, Robert M. "The Decomposition of Effects in Path Analysis." American Sociological Review 40(1975): 37-47.

Andrisani, Paul. J. Work Attitudes and Labor Market Experience: Evidence from the National Longitudinal Surveys. New York: Praeger Publishers, 1978.

Annable, James E., Jr. and Fruitman, Frederick H. "An Earnings Function for High-Level Manpower." Industrial and Labor Relations Review 26(1976): 1107-1121.

Bachman, Gerald. Youth in Transition. Ann Arbor, MI: Institute for Social Research, 1970.

Basmann, R.L. "Letter to the Editor." Econometrica 30(1962): 824-826.

Beilin, Harry. "The Application of General Developmental Principals to the Vocational Area." Journal of Counseling Psychology 2(1955): 52-57.

Bell, Richard Q. "A Reinterpretation of the Direction of Effects in Studies of Socialization." Psychological Review 75(1968): 81-95.

Blalock, Hubert M. "The Identification Problem and Theory Building: The Case of Status Inconsistency." American Sociological Review 31(1966): 52-61.

Blau, Peter M. and Duncan, Otis D. The American Occupational Structure. New York: John Wiley and Sons, 1967.

Blau, Peter M.; Gustad, N.W.; Jessor, R.; Parnes, Herbert S.; and Wilcox, R.C. "Occupational Choice: A Conceptual Framework." Industrial and Labor Relations Review 9(1956): 531-543.

Blumen, Isadore; Kogan, Marvin; and McCarthy, Phillip J. The Industrial Mobility of Labor as a Probability Process. New York: Cornell University, printed by N.H. Humphrey Press, 1955.

Coleman, James S. "The Mathematical Study of Change." In Methodology in Social Research, edited by Hubert M. Blalock and Ann B. Blalock, pp. 428-478. New York: McGraw-Hill Book Company, 1968.

Columbus Area Chamber of Commerce. Columbus 1977-78 Roster and Reference Directory. Columbus, OH: Windsor Publications, 1978.

Crider, Donald M.; Willits, Fernk; and Bealer, Robert C. "Tracking Respondents in Longitudinal Surveys." Public Opinion Quarterly 35(1971): 613-620.

Curry, Evans W.; Hotchkiss, Lawrence; Picou, J. Steven; Scritchfield, Shirley; Stahura, John M.; and Salomone, Jerome. Significant Other Influence and Career Decisions: Volume II: Black and White Female Urban Youth. Columbus, OH: The National Center for Research in Vocational Education, The Ohio State University, 1978.

Curry, Evans W.; Picou, J. Steven; Hotchkiss, Lawrence; Scritchfield, Shirley A.; and Stahura, John M. Significant Other Influence and Career Decisions: Volume I. Black and White Male Urban Youth. Columbus, OH: The National Center for Research in Vocational Education, The Ohio State University, 1976.

Doreian, Patrick and Hummon, Norman. "Estimating Differential Equation Models on Time Series." Sociological Methods and Research 8(1979): 3-33.

Doreian, Patrick and Hummon, Norman P. Modeling Social Processes. Amsterdam: Elsevier, 1976.

Doreian, Patrick and Hummon, Norman P. "Models of Stratification Processes." Quality and Quantity 8(1974): 327-345.

Dohrenwend, Barbara S. and Dohrenwend, Bruce P. "Sources of Refusals in Surveys." Public Opinion Quarterly 32(1968): 74-83.

Duncan, Otis D.; Featherman, David L.; and Duncan, Beverly. Socioeconomic Background and Achievement. New York: Seminar Press, 1972.

Falk, William W. "An Integrative Model of the Occupational Choice Process." In Career Behavior of Special Groups, edited by J. Steven Picou and Robert Campbell. Columbus, OH: Merrill Publishing Company, 1975.

Featherman, David L. and Hauser, Robert M. Opportunity and Change. New York: Academic Press, 1978.

Featherman, David L. and Hauser, Robert M. "Sexual Inequalities and Socioeconomic Achievement in the U.S., 1962-1973." American Sociological Review 41(1976): 462-483.

Featherman, David L.; Sobel, Michael; and Dickens, David. "A Manual for Coding Occupations and Industries into Detailed 1970 Categories and a Listing of 1970-Basis Duncan Socioeconomic and NORC Prestige Scores." Working paper #75-1. Madison, WI: Center for Demography and Ecology, University of Wisconsin, 1975.

Fisher, Franklin M. The Identification Problem in Econometrics. New York: Robert E. Krieger Publishing Company, 1976.

Fox, John. "Simultaneous Equation Models and Two-Stage Least Squares." In Sociological Methodology 1979, edited by Karl F. Schuessler. San Francisco: Jossey-Bass Publishers, 1978, pp. 130-150.

Ginzberg, Eli; Ginsberg, Sol W.; Axelrod, Sidney; and Herma, John L. Occupational Choice: An Approach to a General Theory. New York: Columbia University Press, 1951.

Goldberger, Arthur S. Econometric Theory. New York: John Wiley and Sons, 1964.

Goldthorpe, J. and Hope, Keith. "The Social Grading of Occupations: A New Approach and Scale." In Analysis of Social Mobility: Methods and Approaches, edited by Keith Hope. Oxford: Oxford University Press, 1972.

Gustafson, Kathleen. Minnesota Labor Force Survey Occupation and Industry Coding Manual. Unpublished. St. Paul: Minnesota State Planning Agency, 1977.

Haller, Archibald O. "Reflections on the Social Psychology of Status Attainment." In Social Structure and Behavior: Essays in Honor of William H. Sewell, edited by Robert F. Hauser, David Mechanic, and Archibald O. Haller. New York: Academic Press, (Forthcoming).

Haller, Archibald O. "On the Concept of Aspiration." Rural Sociology 33(1968): 484-487.

Haller, Archibald O. and Butterworth, C.E. "Peer Influence on Level of Occupational and Educational Aspiration." Social Forces 38(1960): 289-295.

Haller, Archibald O. and Miller, Irwin W. The Occupational Aspiration Scale: Theory Structure, and Correlates. Cambridge: Schenkman Publishing Co., 1971.

Haller, Archibald O. and Portes, Alejandro. "Status Attainment Processes." Sociology of Education 47(1973): 51-91.

Hannan, Michael T. and Tuma, Nancy B. "Methods for Temporal Analysis." In Annual Review of Sociology, edited by Alex Inkeles, 5(1979): 303-328.

Haug, Marie R. "Social Class Measurement and Women's Occupational Roles." Social Forces 52(1973): 86-98.

Hauser, Robert M. "Disaggregating a Social-Psychological Model of Educational Attainment." Social Science Research 1(1972): 159-188.

Hauser, Robert M. and Featherman, David L. *The Process of Stratification: Trends and Analyses*. New York: Academic Press, 1977.

Heise, David R. "Causal Inference from Panel Data." *Sociological Methodology*. San Francisco: Jossey-Bass, 1970.

Heise, David R. "Separating Reliability and Stability in Test-Retest Correlation." *American Sociological Review* 34(1969): 93-101.

Henry, Neil W. and Hummon, Norman P. "An Example of Estimation Procedures in a Nonrecursive System." *American Sociological Review* 36(1971): 1099-1102.

Holland, John L. *Making Vocational Choices: A Theory of Careers*. Englewood Cliffs, NJ: Prentice-Hall, 1973.

Hopke, William (Ed.). *The Encyclopedia of Careers and Vocational Guidance*, Vol. II, 3rd ed. Chicago: J.G. Ferguson Publishing Company, 1977.

Hotchkiss, Lawrence. "Testing Status-Discrepancy Hypotheses." Paper presented at the annual meetings of the North-Central Sociology Association, 1981.

Hotchkiss, Lawrence. "Conceptualization of Discrepancy Theory." Paper presented at the annual meeting of the Mid-South Sociological Association, 1980.

Hotchkiss, Lawrence. *Differential Equation Methodology Applied to Career Decisions and Status Attainment Processes: Conceptualization and Calculation*. Columbus, OH: The National Center for Research in Vocational Education, The Ohio State University, 1979a.

Hotchkiss, Lawrence. "Three Interpretations of Differential-Equation Systems." Paper presented at the 1979 annual meetings of the Midwest Sociological Society. Columbus, OH: The National Center for Research in Vocational Education, The Ohio State University, 1979b.

Hotchkiss, Lawrence. "A Technique for Comparing Path Models Between Subgroups." *Sociological Methodology and Research* 5(1976): 53-76.

Hotchkiss, Lawrence; Black, Michael S.; Campbell, Robert E.; and Garcia, Gonzalo. *Theories of Occupational Choice: A Critical Assessment of Selected Viewpoints*. Columbus, OH: The National Center for Research in Vocational Education, The Ohio State University, 1979.

Hotchkiss, Lawrence and Chiteji, Lisa. *Preliminary Findings from the First Two Waves of a Panel Study of Developing Career Expectations*. Columbus, OH: The National Center for Research in Vocational Education, The Ohio State University, 1980.

Hotchkiss, Lawrence and Chiteji, Lisa. *Interim Report on Panel One of a Longitudinal Study of Developing Career Expectations*. Columbus, OH: The National Center for Research in Vocational Education, The Ohio State University, 1979.

Hout, Michael and Morgan, William R. "Race and Sex Variations in the Causes of the Expected Attainments of High School Seniors." American Journal of Sociology 81(1975): 364-394.

Jackson, Elton F. and Crockett, Harry J., Jr. "Occupational Mobility in the United States: A Point Estimate and Trend Comparison." American Sociological Review 29(1964): 5-15.

Johnston, J. Econometric Methods. New York: McGraw-Hill, 1972.

Joreskog, Karl G. "A General Method for Estimating a Linear Structural Equation System." In Structural Equation Models in the Social Sciences. New York: Seminar, 1973.

Kalleberg, Arne L. "Work Values and Job Rewards: A Theory of Job Satisfaction." American Sociological Review 42(1977): 124-143.

Kerckhoff, Alan C. Educational, Familial, and Peer Group Influences on Occupational Achievement. Final Report of the U.S. Department of Health, Education and Welfare, The Office of Education, 1971.

Kerckhoff, Alan C. and Huff, Judith L. "Parental Influence on Educational Goals." Sociometry 37(1974): 307-327.

Klatzky, Sheila R. and Hodge, Robert W. "A Canonical Correlation Analysis of Occupational Mobility." Journal of the American Statistical Association 66(1971): 16-22.

Kmenta, Jon. Elements of Econometrics. New York: The Macmillan Co., 1971.

Kohn, Melvin L. Class and Conformity. New York: Dorsey Press, 1969.

Kohn, Melvin L. and Schooler, Carmie. "The Reciprocal Effects of the Substantive Complexity of Work and Intellectual Flexibility: A Longitudinal Assessment." American Journal of Sociology 84(1978): 24-52.

Koopmans, Tjalling C. "Identification Problems in Economic Model Construction." In Studies in Econometric Method, edited by William C. Hood and Tjalling Koopmans. New York: John Wiley and Sons, 1953.

Koopmans, T.C.; Rubin, H.; and Leipnik, R.B. "Measuring the Equation Systems of Dynamic Economics." In Statistical Inference in Dynamic Economic Models, edited by T.C. Koopmans, pp. 53-237. New York: John Wiley and Sons, 1950.

Kuvlesky, W.P. and Bealer, R.C. "A Clarification of the Concept of 'Occupational Choice'." Rural Sociology 31(1966): 265-276.

Land, Kenneth C. "Significant Others, the Self-Reflexive Act and the Attitude Formation Process: A Reinterpretation." American Sociological Review 36(1971): 1085-1098.

Lewin, Kurt; Dembo, Tamura; Festinger, Leon; and Sneddon Sears, Pauline. "Levels of Aspiration." In Personality and the Behavioral Disorders: A Handbook Based on Experimental and Clinical Research, edited by J. McV. Hunt. New York: The Ronald Press, 1944.

Markus, Gregory B. Analyzing Panel Data. Beverly Hills, CA: Sage Publications, 1979.

McClendon, McKee J. "The Occupational Status Attainment Process of Males and Females." American Sociological Review 41(1976): 52-64.

Mortimer, Jeylan T. "Patterns of Intergenerational Occupational Movements: A Smallest-Space Analysis." American Journal of Sociology 79, 5(March 1974): 1278-1299.

National Occupational Information Coordinating Committee. Vocational Preparation and Occupations, Volume I: Occupational and Educational Code Crosswalk (Interim edition), 1979.

Ohio Department of Economic and Community Development. 1975 Directory of Ohio Manufacturers, 29th ed. Cleveland, OH: Harris Publishing Company, 1975.

Ostrom, Charles W. Time Series Analysis: Regression Techniques. Beverly Hills, CA: Sage, 1978.

Otto, Luther B. and Haller, Archibald O. "Evidence for a Social-Psychological View of the Status-Attainment Process." Social Forces 57(1979): 887-914.

Picou, J. Steven and Carter, Michael T. "Significant Other Influence and Aspirations." Sociology of Education 49(1976): 12-22.

Picou, J. Steven; Curry, Evans W.; and Hotchkiss, H. Lawrence. Significant Other Influence, Career Choice and Achievement: Selected Theoretical and Conceptual Approaches. Columbus, OH: The Center for Vocational Education, The Ohio State University, 1976.

Platt, Otto. Ordinary Differential Equations. San Francisco: Holden-Day, 1971.

Polk, R.L. and Company. Columbus City Directory. Taylor, MI: R.L. Polk and Company, 1977.

Porter, James N. "Race, Socialization, and Mobility in Educational and Early Occupational Attainment." American Sociological Review 39(1974): 303-316.

Portes, Alejandro and Wilson, Kenneth L. "Black-White Differences in Educational Attainment." American Sociological Review 41(1976): 414-431.

Raelin, Joseph A. *Building a Career: The Effect of Initial Job Experiences and Related Work Attitudes on Later Employment*. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research, 1980.

Rehberg, Richard A. and Rosenthal, Evelyn R. *Class and Merit in the American High School*. New York: Longman, 1978.

Rodgers, Roy H. "The Occupational Role of the Child: A Research Frontier in the Developmental Conceptual Framework." *Social Forces* 45(1966): 217-224.

Schuman, Howard and Converse, Jean M. "The Effects of Black and White Interviewers on Black Respondents in 1968." *Public Opinion Quarterly* 35(1971): 44-68.

Sewell, William H.; Haller, Archibald O.; and Ohlendorf, George. "The Educational and Early Occupational Attainment Process: Replications and Revisions." *American Sociological Review* 35(1970): 1014-1027.

Sewell, William H.; Haller, Archibald O.; and Portes, Alejandro. "The Educational and Early Occupational Attainment Process." *American Sociological Review* 34(1969): 82-92.

Sewell, William H. and Hauser, Robert M. *Education, Occupation, and Earnings: Achievement in the Early Career*. New York: Academic Press, 1975.

Sewell, William and Hauser, Robert. "Cause and Consequences of Higher Education: Models of the Status Attainment Process." *American Journal of Agricultural Economics* 53(1972): 851-861.

Sheehy, Linda; Netkin, Debbie; and Grant, Jim. *Social Factors in Aspirations and Achievements Occupation--Industry Coding Handbook 1974-75*. Madison, WI: Center for Demography and Ecology, University of Wisconsin, 1974.

Simon, Herbert A. "The Meaning of Causal Ordering." In *Qualitative and Quantitative Social Research: Papers in Honor of Paul F. Lozarsfeld*, edited by Robert K. Merton, James S. Coleman, and Peter H. Rossi. New York: The Free Press, 1979.

Sorensen, Aage B. "A Model and a Metric for the Analysis of Intragenerational Status Attainment Process." *American Journal of Sociology* 85(1979): 301-384.

Spaeth, Joe L. "Vertical Differentiation Among Occupations." *American Sociological Review* 44(1979): 746-762.

Spenner, Kenneth I. "Temporal Changes in Work Content." *American Sociological Review* 44(1979): 968-975.

Spilerman, Seymour. "Extensions of the Mover-Stayer Model." *American Journal of Sociology* 78(1972): 599-627.

Super, Donald E. *The Psychology of Careers: An Introduction to Vocational Development*. New York: Harper, 1957.

Super, Donald E.; Crites, John O.; Hummel, Raymond C.; Moser, Helen P.; Overstreet, Phoebe L.; and Warnath, Charles F. *Vocational Development: A Framework for Research*. New York: Teachers College Press of Columbia University, 1957.

Suter, L. and Miller, A. "Income Differences between Men and Career Women." *American Journal of Sociology* 78(1973): 962-974.

Taylor, D. Garth. "The Accuracy of Respondent-Coded Occupation." *Public Opinion Quarterly* 40(1976): 245-255.

Temme, Lloyd V. *Occupation: Meanings and Measures*. Washington, DC: Bureau of Social Science Research, 1975.

Thurow, Lester C. *The Zero Sum Society: Distribution and the Possibilities for Economic Change*. New York: Basic Books, 1980.

Tiedeman, David V. "Decision and Vocational Development: A Paradigm and its Implications." *Personnel and Guidance Journal* 40(1961): 15-21.

Tolbert, Charles; Horan, Patrick M.; and Beck, E.M. "The Structure of Economic Segmentation: A Dual Economy Approach." *American Journal of Sociology* 85(1980): 1095-1116.

Treiman, Donald J. and Terrell, Kermit. "Sex and the Process of Status Attainment: A Comparison of Working Women and Men." *American Sociological Review* 40(1975): 174-200.

Tyree, Andrea and Treas, Judith. "The Occupational and Marriage Mobility of Women." *American Sociological Review* 39(1974): 293-302.

U.S. Bureau of the Census. *1977 Census of Oakland California Industry and Occupation Coding Training Manual*. Washington, DC: U.S. Government Printing Office, 1977.

U.S. Bureau of the Census. *1970 Census of Population Alphabetical Index of Industries and Occupations*. Washington, DC: U.S. Government Printing Office, 1971.

U.S. Bureau of the Census. *1970 Census of Population Classified Index of Industries and Occupations*. Washington, DC: U.S. Government Printing Office, 1971.

U.S. Bureau of the Census. *1970 Census Population Occupation by Industry*. Washington, DC: U.S. Government Printing Office, 1972.

U.S. Department of Labor. *Dictionary of Occupational Titles*, 4th ed. Washington, DC: U.S. Government Printing Office, 1977.

U.S. Department of Labor, Bureau of Labor Statistics. Matching Occupational Classifications to Vocational Education Program Codes (Supplement Three of Tomorrow's Manpower Needs). Washington, DC: U.S. Department of Labor, 1975.

Webster, Murray, Jr.; Roberts, Lynne; and Sobieszek, Barbara I. "Accepting 'Significant Others': Six Models." American Journal of Sociology 78(1972): 576-598.

Wilcox, Elane N. "Patient Follow-Up: Procedures, Technics, and Devices for Improvement." American Journal of Public Health 55(1965): 1741-1756.

Wiley, D.E. and Wiley, J.A. "The Estimation of Measurement in Panel Data." American Sociological Review 35(1970): 112-117.

Williams, Trevor. "Educational Ambition: Teachers and Students." Sociology of Education 48(1975): 432-456.

Williams, Trevor. "Educational Aspirations: Longitudinal Evidence on their Development in Canadian Youth." Sociology of Education 45(1972): 107-133.

Wilson, Kenneth L. and Portes, Alejandro. "The Educational Attainment Process: Results from a National Sample." American Journal of Sociology 81(1975): 343-363.

Woelfel, Joseph and Fink, Edward L. The Measurement of Communication Processes: Galileo Theory and Method. New York: Academic Press, 1980.

Woelfel, Joseph and Haller, Archibald O. "Significant Others, the Self-Reflexive Act and the Attitude Formation Process." American Sociological Review 36(1971): 74-87.

Zeeman, E.C. Catastrophe Theory: Selected Papers, 1972-1977. Reading, MA: Addison-Wesley Publishing, 1977.